POST-MORTEM TUBERCULOUS LESIONS :

Their Prevalence and Distribution in 404 Consecutive Examinations conducted at the Royal Infirmary, Edinburgh.

Being a Thesis for the Degree of Doctor of Medicine in the University of Edinburgh, by

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INTRODUCTION

Tuberculosis is an endemic disease common to all civilised countries. It accompanies civilisation when it penetrates amongst aboriginal peoples. As usually met with it is a chronic malady, but in the virgin races amd in early childhood it runs an acute and frequently fatal course. The disease lasts many years and in the majority of cases exhibits a tendency to arrest and cure. Usually commencing insidiously it runs its chronic course interrupted, however, by various exacerbations. During the periods of lowered resistance the patient occasionally succumbs to the primary disease or to any intercurrent infection which may thus have been afforded an opportunity of developing. Although it is not usually a fatal disease it creates by virtue of its chronicity a very serious economic problem. The capacity for work of the patient is usually below that of a correspondingly normal individual; and in many instances they are quite unable to follow their usual avocations.

The disease is so protean in its manifestations and the objective signs so slight in many cases that frequently one hesitates to diagnose its presence till the condition is more advanced. Numbers of these cases spontaneously cure themselves and are then forgotten. But the remainder which do not terminate so

favourably are allowed to go on, and when definite signs are discovered treatment is instituted which may lead to a satisfactory termination, notwithstanding a certain amount of permanent disability. Now if these patients had had the advantage of treatmant from the onset when the disease was first suspected, they would have been saved long periods in sanatoria and would have a better chance of complete cure and without any permanent defect. The facts presented in the present work show the large number of cases where the tuberculous lesions have attained a complete cure and also that comparatively large lesions reach such a termination.

In studying the epidemiology of the disease various methods may be adopted. The one very often relied on is from the death statistics, but these only record those cases actually dying of the disease. They leave out of account those that are carried off by other conditions, and obviously nothing can be found out about the healed cases.

The next method which might be tried would be the clinical survey of a community. At first sight this would seem to produce a truer indication, but the value of the investigation would rest on the clinical acumen of the observer and to some extent in the less obvious cases on his personal bias. Old cases with

healed lesions and many quiescent ones would be missed altogether. The assistance of tuberculin reactions might be used, but they are not sufficiently reliable for an investigation of this type. What would appear to be the perfect method of studying the epidemiology of tuberculosis would be by post-mortem examination of all deaths occurring in a selected area. The individual factor also comes into play here. If the post-mortem reports for any institution be examined with this object, it will soon be evident that the presence or absence of tubercles has only been noted in a few. Where a negative finding has been recorded we have no evidence of the extent to which the search was prosecuted. Unless a lesion or condition is keenly searched for it will usually be overlooked, consciously or unconsciously. This applies particularly to tuberculosis as the lesions so often are very small and situated in unusual parts of the body. To obtain reliable statistics the pathologist must examine all cadavera passing through his department with the definite object of proving the presence or absence of tubercle in each body. Many of the cases will be easily dealt with, as tuberculosis selects certain sites by perference, e.g. the apices of the lungs and the lymph glands of the thorax and abdomen, but no organ or tissue is immune to the tubercle bacillus. When no gross lesion has been found in any of the common situations, a more minute examination of those organs must be made and

thereafter every other organ must be similarly dealt with. Clearly these are the difficult cases as they take a long time, and when a very small pathological change is found it is usually impossible to diagnose its condition until microscopic sections have been made. As the earliest change may be so small as to escape the naked eye, all the usual sites of tuberculous infection of the body in otherwise negative cases should be subjected to microscopic examination. Even for one case this would be a colossal amount of work, and the object in view would not be worthy of such an expenditure of energy. The negative and doubtful cases might be treated by inoculating all the common sites of tuberculosis into experimental animals and awaiting the results. A modified form of this test was carried out in the negative cases which I examined. Production of the disease in animals would only mean that virulent tubercle bacilli had been present in the tissue inoculated without necessarily there having been any anatomical change in the body. On the other hand the animal test would fail to reveal the presence of healed lesions in which the bacilli had died or become avirulent. It has been observed by several writers that animal inoculation has shewn the presence of tubercle bacilli in organs which did not reveal tubercular nodules on microscopic examination. This applied chiefly to tonsils and cervical lymph

glands of children. The organs were cut in half, one half being used for inoculation and the other for microscopic examination. It has also been shown that the bacilli can pass through mucous membranes and superficial tissues without leaving any trace. It is thus possible for a tuberculous infection to occur without affecting any of the anatomical changes in the tissues which indicate the presence of tuberculous disease. Infection is more or less transient and usually leads to disease, though it can be premised that the body resistance can, in favourable circumstances, overcome a mildly virulent strain of the invading organism. Animal inoculation then would, it is true, declare the presence of tuberculous infection; but only by microscopic or naked eye examination could we determine whether such infection had reached the stage of actual tuberculous disease. In the present study we shall confine ourselves to an examination of the prevalence of the disease itself as indicated by the presence of actual tuberculous lesions.

The Royal Infirmary of Edinburgh draws its patients chiefly from that City and the surrounding counties. The City population on the whole live under satisfactory conditions but there are certain areas in the industrial parts where the housing is very bad and unhygienic. The neighbouring districts are agricultural with a few small towns and several

groups of mining villages. The patients examined may thus be taken as representative of the types composing the working people of this country.

HISTORICAL.

Tuberculosis has been known under various names since the time of Hippocrates. In the seventeenth century Sylvius described the connection between the gross morbid anatomy of the tubercle and the clinical condition. William Stark in the middle of the eighteenth century very accurately described the morbid anatomy of tuberculosis of the lungs; he based it on the results of 10 post-mortems of pulmonary tuberculosis. Next Baillie described tubercles in other viscera. During the first quarter of the nineteenth century Laennec did much to correlate the clinical phenomena and the physical signs with the pathological conditions of the lungs. The infectivity of tuberculosis was proved by Villemin in 1865. Koch gave a great impetus to the study of this condition when he discovered the causal organism in 1882. Since then the pathology has been thoroughly investigated along innumerable lines and repeatedly checked by various observers, but it is only during the last 30 years that any considerable amount of work on the incidence of the disease, as revealed by pathological methods, has been undertaken. Pfevious to this period M. Lombard analysed 910 cadavera in the Childrens' Hospital, Paris, during the first quarter of the nineteenth century; he found that a considerable

proportion of them showed tubercles. Between 1879 and 1886 Kingston Fowler performed 1943 postmortems in the Middlesex Hospital, London and especially looked for evidence of tuberculosis in the lungs in any stage of the disease. He found it in 177 cases, that is, in 9 per cent. of all deaths. Similar percentages were obtained by Sidney Martin during 1890--1891 in the same Hospital, when he found tuberculosis lesions in 42 cases out of 445, which equals 9.47 per cent. Birch-Hirschfeld from Leipsig was amongst the first on the Continent to present statistics of the occurence of tuberculous lesions in people dying from all causes. During the period 1895-1897 he examined 3067 bodies and found signs of tuberculosis in 41.86 per cent. Pulmonary tuberculosis was the cause of death in 24.3 per cent,, and was present in a wide-spread and active condition, but was not the fatal cause in a further 3.4 per cent. 11.97 per cent of cases had cicatrised lesions and 2.8 per cent. had latent commencing areas. He selected a group of 826 which had died of acute diseases other than tuberculosis and of accidents and found tuberculosis of the lungs in 171 or 26.7 per cent. There were 105 cases (12.7 per cent.) with cicatrised tubercles in the lungs, 31 cases (3.8 per cent.) with active pulmonary disease, 35 cases (4.2 per cent.) were of scarred lungs with some secondary outgrowths. Birch-Hirschfeld says that the spread

of tuberculosis in the cases from the Leipsig Hospital must indicate approximately that in the general population.

In 1900 Naegeli published his astounding figures after much painstaking work extending over several years in the Pathological Institute of Zurich. He set out with the express purpose of finding the exact number of cases which showed evidence of tubercle. He examined 500 bodies in several series of consecutive cases and found 71 per cent. to be affected. The subjects died of all causes including tuberculosis. Amongst children up to 18 years of age tubercle was present in 28 per cent. In adults over 18, 98 per cent. had definite signs of tuberculosis and of these only 28 per cent. died of the disease.

Reinhart autopsied 360 adults in Berne Pathological Institute and found tuberculous disease in 96.38 per cent. Of the thirteen negative cases nine were under 30 years of age. In 63.9 per cent. the lesions were healed and the remainder were active. Amongst the 72 children examined 29.16 per cent. showed active lesions although only 16.8 per cent. died of tuberculosis. Infants under 1 year had 7.14 per cent. of positive results. 28 new born infants were completely negative.

Opie of St. Louis, U.S.A. presents the results of 93 autopsies on children and of 50 on adults. The

Childrens' Hospital accepted all diseases whereas the adult Hospital did not accept tuberculous patients. He radiographed the lungs and bronchi and then cut down on the tuberculous lesions. The lesions were shown up on account of the calcium salts which they contained. With increasing age there was a greater tendency to encapsulation. Of the 93 cases under 18 years 22 (23 per cent.) had tuberculous lesions of which half were fatal. The percentage of tuberculous cases increased rapidly after the second year, and after the fifth year the proportion of non-fatal to fatal cases materially improved. The fifty adult cases all showed tuberculous lesions in lungs or bronchial glands. Three of these cases were of fatal tuberculosis; one sixth were active; in about half the cases the lesions were encapsulated, and in rather more than one third the lesions were healed. For the various age periods the proportions remained approximately the same. In the greater number of cases only one focus of infection was found.

Lubarsch in his paper has collected his own various statistics and also those of other continental observers. Each of them had performed a sufficient number of autopsies to give a fairly reliable figure and yet the percentage varies in different cities from 36 of Lubarsch in Zwickau and Risel in the same place to 93 of Naegeli in Zurich. Most of them had been taken

from post-mortems examinations in hospitals of large towns which admit only poor patients, and they as a class suffer most from the ravages of tuberculosis.

During the European War Hart performed 573 post-mortems on German soldiers who had died of wounds or of acute infectious diseases. These men, young adults of 18 to 30, were from the provinces of Germany and 208 of them worked on the land in civil life, and they had then probably not been exposed to repeated large doses of tubercle bacilli, which is such a common occurrence in city life; we would therefore expect to find smaller proportions of infected cases among them. Out of these 573 cases, tuberculosis was found in 196, that is 34 per cent. The division of these cases is as follows :-

Tuberculous Meningitis -	13	
Miliary Tuberculosis -	5	
Caseous Lymphadenitis -	27	45
Obsolete Tubercles of Lung & Trachio-bronchiated Glands -	121	
Obsolete Tubercles of other Glands	30	151

These 151 cases represent healed lesions and form 27 per cent. of the total numbers. Hart performed all these examinations himself so that the results are uniform. He gives the figures from other two

German observers in the same class of case, viz., Rössle, who found 33 per cent. cases positive and Obendorfer who found 10 per cent. Of course these are from a selected population, in fact they are amongst the flower of German manhood and so are not comparable with results obtained by Fowler & Naegeli, etc. Considering that all these men were subject to a rigid medical examination before joining the Army in the field, it is significant that 34 per cent. had anatomical lesions. It is to be noted that the cases with active tuberculous lesions had them in the form usually met with in children. One would conclude from this that a considerable proportion of the rural population of the German provinces which provided the men for the formation with which Hart was serving when he made these observations had not been infected with tuberculosis. The same was observed among the French African troops after they had been in France some time and also among our own coloured troops.

Rose Bradford has given us the results of post-mortems in our own Armies perfprmed by Shore in the Etaples area during 1917 & 1918. This was on a selected population. 2121 examinations were made and in 256 instances or 12 per cent. were tuberculous lesions found. Of the 256 cases death was due to tuberculosis in 62 of them. Excluding those dead of

tuberculosis 194 cases were found to have tuberculosis out of 2059 which work out at 9 per cent. Amongst the British, Canadian and Australian troops the percentage was very similar, viz., between 11 and 12 per cent. One series of 1513 post-mortems produced 146 cases of tuberculosis with the following anatomical distribution : pulmonary 113 (7.5 per cent.); glandular 74 (4.9 per cent.); miliary 14 (0.9 per cent.); renal 20 (1.3 per cent.); peritoneal 14 (0.9 per cent.) In the 113 pulmonary cases 27 (23.9 per cent.) were in an active state, 21 (18.6 per cent.) the disease was chronic and in 65 (57.5 per cent.) it was quiescent. Of the 74 glandular cases the lesions were situated in the thoracic group 34 times, 32 times in the abdominal group and 3 times in both. Shore performed a number of autopsies on natives of South Africa, West Indies and New Zealand, and he found that the incidence of tuberculosis was high amongst them. Amongst the Imperial troops, although the incidence was the same, the death rate varied as shown in the following table :-

	No of Autopsies	Tuberculosis		Fatal cases of Tuberculosis.	
		No.	%	No.	%
British -	1650	188	11.39	31	16.5
Canadians -	220	26	11.81	7	26.9
Australians -	93	11	11.82	5	45.4
New Zealanders -	56	10	17.87	8	80

Shennan, when he was pathologist to the Royal Hospital for Sick Children, Edinburgh, during the periods 1886-1902 and 1910-1913, looked for tuberculous lesions in the bodies which came to him for examination. The majority of the deaths occurred in the first three years of life. His last age group, 5-14 years, is rather wide in its range.

	0-1 year	1-3 years	3-5 years	5-14 years	
Number per age group	381	418	171	307	- 1277
Non-tuberculous cases -	314	236	86	144	- 780
Number with tubereulosis	67	182	85	163	- 497
Percentage of tuberculous cases	17.6	43.5	49-7	53.1	- 38.8 per cent.

De Besche, whom Shennan quotes, had investigated 134 children's bodies with the same object and had found a slightly higher percentage of tuberculous cases. The figures obtained by H. Albrecht are very slightly lower than those of Shennan.

Shennan investigated the prevalence of tuberculous lesions in the various groups of lymphatic glands during both periods at the Sick Children's Hospital. The results are as follows ;-

	1886-1902	1910-1913
Tuberculosis in Lymph glands	83.7 %	69.4 %
" " Thoracic "	69.2 %	53.1 %
" " Abdominal "	54.4 %	45.0 %
" " Both groups of "	39.9 %	29.7 %
" " Thoracic " alone	29.5 %	15.3 %
" " Abdominal " "	13.5 %	13.5 %

The de_crease in most of the groups will be noticed. He attributed this to the Anti-Tuberculous Campaign which was being actively carried on in the City. During 1886 to 1902 there were 33 cases or 11.7 per cent of tuberculous thoracic glands without tuberculous lesions in other organs. 105 (47.5 %) cases of abdominal tuberculous glands showed no ulceration of the intestines. 73. (33 %) of abdominal gland cases had no excavation of the lungs.

Of the total number, 497, of tuberculous cases death was caused by meningitis in 228 or 45.8 per cent. 183 times mediastinal root glands were involved. The right side were more affected or alone affected in 123 (57.2 %) cases and the left side, alone or more affected in 60 (32.8 %) cases.

In 127 pulmonary tuberculous cases the right side alone was involved 42 per cent., the left side alone 28 per cent. and both sides 28 per cent.

Agnes Macgregor was pathologist at the same hospital during the period 1922-1924 and performed

194 autopsies on children up to the age of 12 years. 177 were under 5 years and about 90 were under 1 year. 42 cases (22 %) had tuberculous lesions. Tubercle was the cause of death in 33 or 17 per cent. of cases; of the remaining tuberculous cases, three were being treated for tuberculosis of bones or glands, so that latent tuberculosis was only present in 6 cases or 3 per cent.

In the 42 tuberculous cases the advanced lesions were distributed as follows :-

Cervical glands	2 cases	5 %
Thoracic "	21 "	50 %
Mesenteric "	22 "	52 %

In three of the cases advanced lesions were found in two groups of glands.

In the 33 fatal cases the distribution was :-

Cervical glands	1 case	3 %
Thoracic "	19 "	58 %
Mesenteric "	16 "	49 %

The number of cases in each group with the percentage of fatal cases was instructive :

Cervical glands	2 cases	1 fatal case	50 %
Thoracic "	21 "	19 "	90.5 %
Mesenteric "	22 "	16 "	73. %

Acute miliary tuberculos~~e~~is with meningitis accounted for 21 deaths or 50 per cent. of total cases and 65.5 per cent. of fatal cases.

Healed lesions were found in three cases only; mediastinal glands and lungs, one case aet. 4, mesenteric cases two cases aet. 4 and 5 years.

Ghon in an examination of 170 children's cadavera up to 14 years of age found signs of calcification in 36 or 21 per cent. The youngest case to show calcification was 18 months.

TECHNIQUE EMPLOYED IN THE PRESENT INVESTIGATION.

It was desired to obtain as true an estimate as possible of the incidence of tuberculosis amongst the population of Edinburgh. For the reasons suggested above it was decided that this should take the form of a special examination for all and any signs of tuberculous disease occurring in a consecutive series of postmortems conducted in the Royal Infirmary, Edinburgh. The investigations extended from November 1922 till February 1924 and embraced 404 cases. The method adopted was to examine the skin for signs of lupus and for scars of operations which might have been for tuberculous disease. Next the neck was palpated for enlarged cervical glands. After the body was opened the presence or absence of pleural adhesions was noted. When the thoracic contents were removed I closely examined the neck and dissected where necessary to get any group of glands which had escaped discovery. After the pathologist had completed his survey of the lungs I looked for areas of thickened pleura or scars; their position and shape were noted, and then each lung was cut into thin slices and carefully inspected and digitally examined. Along the bronchi the

the glands were cut into and special attention was paid to the glands at the bifurcation of the trachea. All the paratracheal glands were closely examined. In the abdominal cavity miliary tubercles or caseous masses in the peritoneum were looked for, then the condition of all the mesenteric glands was examined, special attention being paid to the glands at the root of the mesentery and in the ilio-caecal regions. The intestines were opened and scrutinised throughout their length for ulceration. The liver and spleen were each cut into slices for more close examination. Each kidney was finely sliced, and the course of each ureter palpated for nodules. Any organ which from the clinical findings or pathological state was suspected of a tuberculous change was thoroughly examined after careful dissection and thereafter submitted to a histological examination. When there was any doubt as to the diagnosis sections were made for microscopic work. Those cases in which no naked eye tuberculosis was found were tested by animal inoculation. An emulsion was made from cervical and thoracic and abdominal glands and inoculated into one or two guinea-pigs. Where the apical pleura and lung were not quite healthy they were also included in the emulsion. This method was open to gross fallacies.

Rabinowitsch found that inoculation of calcified glands in which no tubercle bacilli could be seen

microscopically produced tuberculous lesions in animals. This occurred in her cases four times. Cobbett showed that caseous lymph glands from children might contain tubercle bacilli visible through the microscope and yet be incapable of causing the disease in guinea-pigs. A.S. Griffith had the same experience with caseo-calcareous glands in children and also in adults. This is an important observation and indicates that not every caseous node is a potential source of further spread; what the relative proportion is of these non-infective glands is unknown. On the other hand numerous observers have inoculated apparently healthy, even microscopically healthy, lymph glands into guinea-pigs and produced the disease. These latter instances then are an example of tuberculous infection and not of tuberculous disease. In the great majority of cases when Koch's bacillus enters the body it produces the anatomical tubercle and so causes the disease tuberculosis. Occasionally the bacillus does not cause any pathological change in the host and so can only and is only discovered by animal inoculation . This is only a tuberculous infection and is the reason for the large number of reactors to tuberculin in whom no symptoms nor signs of tuberculosis have been found. So the evidence of tuberculosis rests on the microscopic recognition of changes from normal which experience has taught us are tuberculous; in many cases the lesions will

require microscopic examination to confirm the diagnosis.

I decided to accept the following facts as evidence of tuberculosis. A definite tuberculous lesion in any organ, also caseous and calcareous nodules in any site commonly affected by tuberculosis. Thickening of the pleura or apical scara were not accepted on their own merits, but when occurring without any other signs they were classified separately.

Patients under 12 years of age are not usually admitted to the Infirmary and likewise those suffering from tuberculosis are treated elsewhere.

T A B L E I.

AGE	TOTAL EXAMINED	TUBERCULOSIS PRESENT		NO TUBERCULOSIS	
		No.	%	No.	%
0-10	4	3	75	1	25
11-20	26	19	73	7	27
21-30	44	30	68	14	32
31-40	46	28	61	18	39
41-50	80	50	62.5	30	37.5
51-60	107	81	75.7	26	24.2
61-70	66	47	71-3	19	28.7
71-80	22	19	86.4	3	13.6
81 +	5	4	80	1	20
Age un-known	4	3	75	1	25
TOTAL :	404	284	70.2	120	29.7

THE INVESTIGATION AT THE ROYAL INFIRMARY. EDINBURGH.

In the above manner 404 cadavera were examined. They were not a selected population except in one way, namely, that cases of active tuberculosis were not usually admitted to the Institution. A few cases certainly were admitted either by accident or for special reasons and died from that condition.

The patients admitted are in the main but not entirely from the poorer classes of the population. For the sake of brevity the cases which died of tuberculosis will be referred to as fatal tuberculous cases, and the remainder which died of other conditions as non fatal cases. Positive indicates that tuberculosis was present in that body. Most of the deductions and tables have been made with reference to the non fatal cases only.

Four of the cases were under 10, and 26 between 11 and 20, and in 4 cases no age was obtainable. The majority of the bodies examined were between 21 and 70 with the highest number between 51 and 60.

Of the total 404 cases, 284 or 70 per cent. showed definite signs of tuberculosis. The remaining 120 included 46 with patches of fibrous tissue or scars in the lungs, 12 with only pleural adhesions and 62 with no sign anywhere of tuberculosis.

TABLE II

ANALYSIS OF CASES WITH NO SIGNS OF TUBERCULOSIS.

AGE	NO TUBERCULOSIS		PLEURAL FIBROSIS		PLEURAL ADHESIONS		TOTAL NEGATIVE	
	No.	%	No.	%	No.	%	No.	%
0-10	1	25	-		-		1	25
11-20	7	27	-		-		7	27
21-30	8	18	4	9	2	4	14	32
31-40	17	36	1	2	-		18	39
41-50	15	18	13	16	2	2	30	37.5
51-60	6	5	15	14	5	4	26	24
61-70	7	10	19	28	3	5	19	28.7
71-80	1	4	2	9	-		3	13.6
81+	-		1	20	-		1	20
Age unknown	-		1	25			1	25
Total	62	15	46	11	12	2.9	120	29.7

Pleural adhesions are frequently looked upon as the result of a tuberculous pleurisy, but they may also occur as the result of other inflammatory processes either from a transient bacterial infection or from trauma to the chest wall. Without other more definite evidence of tuberculosis I did not feel justified in including them amongst the positive cases. The adhesions in these cases were often so slight as to escape notice unless they were carefully searched for by digital examination before the lungs were removed from the thorax.

The position as regards the apical scars is rather different. Here we are dealing with an area of fibrous tissue in the pleura at the apex of a lung, which produces a definite thickening of the pleura and projects for a varying distance into the lung substance. In some cases it chiefly involves the lung tissue and may not invade the pleura as well. Histological examination shows that these are composed of fibrous tissue, similar in structure to the fibrous tissue round a calcareous or caseous nodule. We know that chronic bacterial inflammation leads to fibrous tissue formation. These areas of scar tissue largely predominate at the apex of the lungs, and the most common cause of chronic inflammation at these points is the tubercle bacillus. It is also known that tubercle which are cured become so

TABLE III

CASES DYING OF TUBERCULOSIS.

AGE	TOTAL EXAMINED	FATAL TUBERCULOSIS		NON-FATAL TUBERCULOSIS
		No.	%	
0-10	4	1	25	3
11-20	26	5	20	21
21-30	44	3	6.8	41
31-40	46	0	0	46
41-50	80	4	5	76
51-60	107	3	2.8	104
61-70	66	2	3	64
71-80	22	0	0	22
81+	5	0	0	5
Age unknown	4	0	0	4
TOTAL	404	18	4.4	386

by the formation of fibrous tissue. This has been abundantly proved by naked eye and microscopic examination of tubercles in various stages of arrest. Similar scars occur in close association with caseous and calcareous nodules in the apices. All these facts form strong presumptive evidence that these apical scars are of tuberculous origin. However, in the absence of vigorous proof of their tubercular origin I have excluded them from the positive statistical material.

These scars varied in size from easily perceptible thickenings up to areas of an inch or more square and one quarter inch deep. Sometimes the pleural surface of the scar was smooth and sometimes puckered. The colour varied between white and gray depending on the thickness and admixture of carbon pigment. A few of the scars were avascular on microscopic examination, while the majority contained numerous blood vessels and groups of small round cells. In a large proportion of instances the fibrous tissue was arranged in layers parallel to the pleural surface. (See Drawing.)

In the first place let us consider the 22 cases of active tuberculosis. In four of these death was due to other causes.

No. 15 - male, 69 years. Infiltrating caseous tuberculosis of mesenteric glands. Died of carcinoma of liver and gall bladder.

No. 24 - male, 58 years. Calcareous deposits

in upper lobes of both lungs and in broncho-pulmonary glands. Small patch of tuberculous broncho-pneumonia in right upper lobe. Died of cerebral softening.

No. 46 - Male, 63 years. Area of tuberculous consolidation in each apex about 2½" x 1". Death was the result of chronic duodenal ulcer and chronic pancreatitis.

No. 262 - Male, 55 years. There was a cap of thick fibrosed pleura over the right apex. In the right lower lobe was a hard mass about 1" x 1" x ½" which microscopically was found to be tuberculous broncho-pneumonia. There were also some calcareous spicules in the right trachea-bronchial glands. Death was from acute peritonitis.

From this group, small though it is, it will be seen that tuberculosis is found as an active disease in elderly subjects without being the actual cause of death. The activity was in each case of a low grade, but not without an unfavourable influence on the body economy. In the three last cases is added the risk of infectivity to other persons.

The remaining 18 cases in which death was due to the disease itself may be divided into the following groups.

1. Acute miliary tuberculosis :
2. Tuberculosis chiefly of lungs :
3. Generalised tuberculosis :

1. Acute Miliary Tuberculosis :

No. 374 - male, 44 years. Vomica in each upper lobe, miliary tubercles throughout left lung, meninges, spleen, liver and ileo-caecal glands.

No. 79 - female, 15 years. Tuberculous left hip joint, caseous node about ¼ diameter in upper lobe of left lung, also recent tuberculous consolidation of left upper and lower lobes. Right lung free. Tuberculous meningitis. Miliary tubercles on peritoneum and intestinal mucosa. Kidneys, miliary tubercles with calcareous material in left renal pelvis.

No. 149 - male, 58 years. Two caseous nodes ¾" diameter in right upper lobe. Recent miliary tubercles in both lungs especially the upper lobes, also in kidneys and meninges. One calcareous node 1/8" diameter in mesentery.

No. 188 - female, 3 years. Mass of caseous, tracheal and bronchial glands; miliary tubercles throughout both glands, liver, spleen, kidneys, meninges and a few in the thyroid.

No. 55 - male, 24 years. Miliary tubercles of meninges and right lung, kidney and spleen. Calcareous tracheo-bronchial glands. Mesenteric gland and left posterior cervical glands caseous. Liver one nodule about 1/8" diameter found and histologically proved to be tuberculous with giant cells and caseation.

No. 144 - female, 19 years. Right lung contained four caseous nodes between apex and hilus, the largest was ½" diameter, another lay close to the axillary border and was surrounded by a fibrous capsule; this was proved histologically to be tuberculous with a necrotic centre & with giant cells at the periphery. Lymph glands at the hilus on both sides were caseous. Mesenteric glands and para-aortic (thoracic and abdominal) caseous and calcareous. Miliary meningitis.

No. 223 - female, 17 years. Acute fibrinous pleurisy and pleural adhesions on left side. Miliary tubercles in left lung, more numerous near the pleura, miliary tubercles in upper lobe of right lung. Bifurcation gland and left broncho-pulmonary gland caseous. Excess of cerebral fluid and meningeal tubercles present.

No. 87 - male, 15 years. Tuberculous meningitis. (Permission only granted for examination of head.)

These cases demonstrate the accepted fact that acute miliary tuberculosis only occurs in a patient who harbours a tubercular focus, be it active or latent, in some part of his body. It will also be noted that the miliary cases occurred in two groups of patients, one group just after puberty and the other of full grown adults up to 58 years.

2. Tuberculosis chiefly of Lungs.

No. 155 - male, 52 years. Tuberculous broncho-pneumonia in right lung. A few calcareous spicules in tracheo-bronchial glands.

No. 163 - Male, 67 years, miner; pleural adhesions and anthracosis. Left apex, cavity; right apex cavity with

with fibrosis spreading out from it. Kidneys, caseous tubercles, up to 1/8" diameter.

No. 177 - male, 26 years. Acute pulmonary tuberculosis. Pleural adhesions on both sides. In right lung recent cavities with small outlying tuberculous foci and fibrosis; recent cavity in right middle lobe; small pinhead lymph spread tubercles in right lower lobe. Left upper lobe cavity with no fibrosis; numerous small lymph spread tubercles in both upper and lower lobes. Cervical, thoracic and mesenteric glands free.

No. 227 - male, 42 years. Chronic pulmonary tuberculosis. Adhesions over both right and left lungs. Right lung; thick scar tissue at apex with a large cavity immediately subjacent from which a recent haemorrhage had taken place; there was an increase of fibrous tissue round the cavity and also a few small tubercles. Left lung; scars at apex with several small cavities and lymph spread tubercles. The glands in all areas were free.

No. 333 - male, 52 years. Acute caseous broncho-pneumonia in both lungs with a small calcareous node in right lung and also in trachea-bronchial glands.

No. 398 - male, 68 years. Old chronic tuberculosis at both apices and tuberculous broncho-pneumonia in both lower lobes. Tuberculous ulcer in each true vocal cord at posterior end.

3. More Generalised Tuberculosis.

No. 135 - female, 41 years. In right lung a momica occupied almost all the upper lobe with thick fibrous adhesions over its anterior surface to the parietal pleura; remainder of lung was occupied by confluent tuberculous broncho-pneumonia; bronchial glands showed tuberculous infiltration. Left pleural cavity contained fibrous pleurisy and a purulent exudate. Round the hilus and more especially in upper part of lower lobe were numerous small cavities and tuberculous bronchiectatic cavities; remainder of lung was solid with tuberculous broncho-pneumonia. Left kidney was small and the pelvis

contained calcareous sand, and caseous material was at both apices. Spleen contained a calcareous nodule 1/8" diameter.

No. 240 - male, 29 years, miner. Cervical glands on both sides were enlarged, firm and white, in places caseous, which on the left side discharged by a sinus. Left lung contained two cavities about ¾" diameter, one at the apex, the other at lower anterior node. In the lower lobe the bronchioles were all dilated especially towards the lower free margin. Tuberculous broncho-pneumonia was throughout the right lung, and there was a calcareous node at the lower anterior border. Mediastinal glands and about one dozen in the gastro-hepatic omentum were caseous. Spleen contained two caseous nodes about ¼" x 1/8". Numerous miliary tubercles on meninges.

No. 168 - male, 14 years. Pharyngeal and para-tracheal glands caseous. Both lungs early tuberculous broncho-pneumonia. Spleen one small caseous node. Two tubercles above cords of

larynx. Right tibia lower end tuberculous periostitis which had recently been under surgical treatment. Tuberculous meningitis.

No. 382 - male, 45 years. Left kidney contained multiple tubercles and abscesses; with a perinephritic abscess from which tubercle bacilli and streptococci were isolated. Right kidney showed a few early tubercles. Both ureters were dilated. Bladder was dilated and ulcerated. Spleen showed small yellow foci which the microscope confirmed as tubercles.

Although these cases might be termed accidental admissions to the Infirmary, they are examples of the different manipulations of tuberculosis. As regards age, two subjects over sixty died of tuberculosis; both of them had old-standing pulmonary lesions. It will also be noticed that tuberculous broncho-pneumonia is not confined to the three first decades of life.

The four cases grouped as active non-fatal tuberculosis are included with the active caseous lesions to form the class of total active cases. Cases were put under the heading of caseous when the lesions were in a caseous or caseous and calcareous state; they are always circumscribed lesions in contra-distinction

to caseous areas forming part of more irregular tuberculous consolidation. Tuberculosis may spread from a caseous nodule and set up a generalised form of the disease as has been illustrated in several of the cases of the above groups. On the other hand, as Griffith has pointed out, caseous lesions may not be infective to guinea-pigs, in every case. As the lack of infectivity of caseous material only occurs in a small proportion of cases investigated by other observers, an anatomical division of the caseous cases was adopted in the present series. (A) Active disease present, where there was no definite or complete capsule to each lesion. (B) Cases in which from anatomical and histological examination, it was difficult to determine whether the lesion was active or arrested. (C) Latent or arrested cases where the caseous area was enclosed by a calcareous or fibrous envelope and therefore not in a position to discharge bacilli or their toxins into the host.

		Unknown Age	0-10	11-20	21-30	31-40	41-50	51-60	-70	-80	-90
Group A	12	-	-	1	1	3	2	1	3	1	-
Group B	19	1	-	2	3	2	3	5	1	1	1
Group C	35	--	1	3	4	4	2	12	7	1	1

41 of the 66 cases contained calcareous material as well as the caseous either in the same lesion or at a different site.

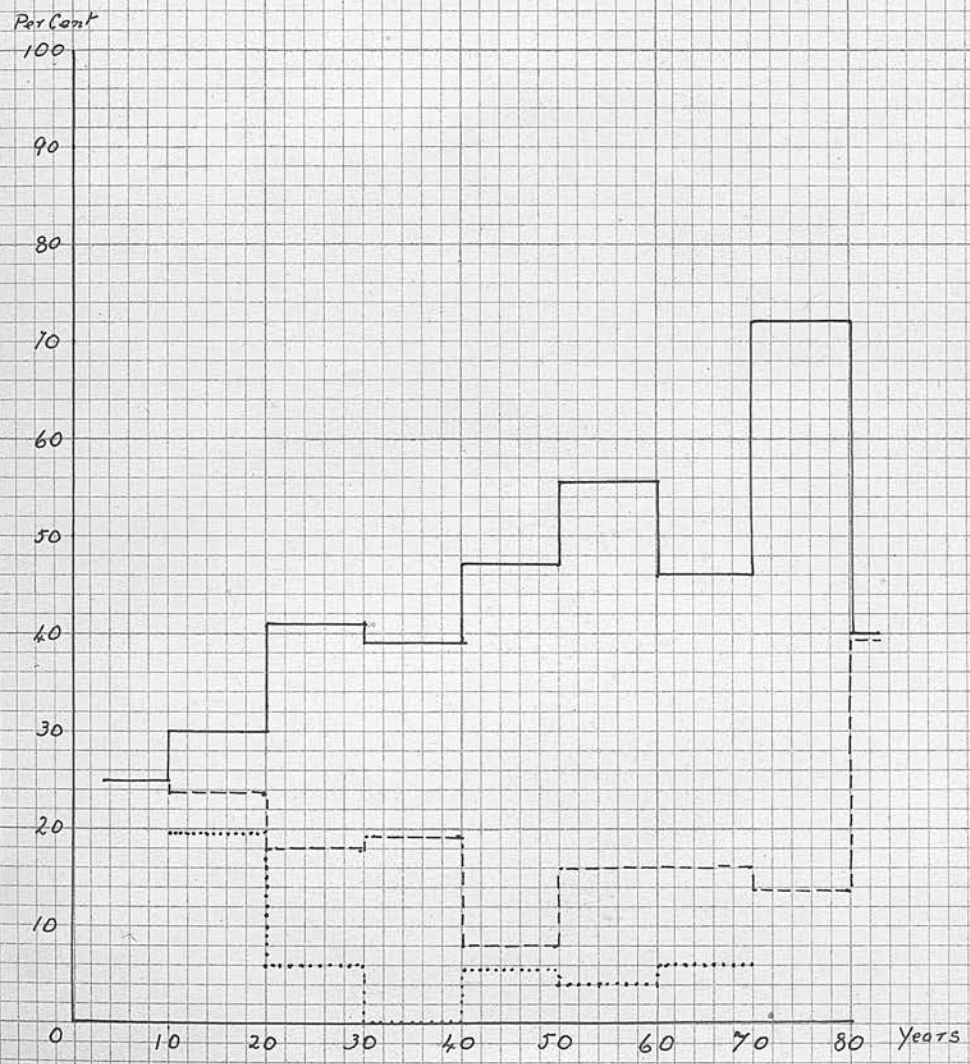
For practical purposes we can add to Groups A & B the four active cases mentioned before, giving a total

T A B L E IV

CHIEF PATHOLOGICAL DIVISIONS.

AGES	TOTAL EXAMINED	CALCAREOUS LESIONS		CASEOUS LESIONS		ACTIVE LESIONS		HEALED LESIONS
		No.	%	No.	%	No.	%	
0-10	4	1	25	1	25	1	25	-
11-20	26	8	30	6	23	5	19	1
21-30	44	18	40.9	8	18	3	6	1
31-40	46	18	39	9	19	0	0	1
41-50	80	38	47	7	8	4	5	1
51-60	107	59	55	18	16	5	4	-
61-70	66	31	46	11	16	4	6	-
71-80	22	16	72	3	13	0	0	-
81 +	5	2	40	2	40	0	0	-
AGE UNKNOWN	4	2	50	1	25	0	0	-
TOTAL	404	193	47.7	66	16	22	5.4	3

SEE GRAPH I



GRAPH 1

FROM TABLE IV

——— CALCAREOUS LESIONS

– – – – CASEOUS "

..... ACTIVE "

of 35 cases of active tuberculosis without being the cause of death.

In the 35 cases of Group C the caseous lesions were in a state of latency at the time of death, but on the occurrence of any of the accidents to health which are liable to occur they would be potential sources of re-activation of the disease.

(Table IV Graph 1)

Let us now turn to the cases in which the only sign of tuberculosis was the presence of calcareous nodules. Calcareous nodules are frequently associated with those of a caseous or active nature. These cases have been classified with the active or caseous lesions. The nodules were frequently solitary.

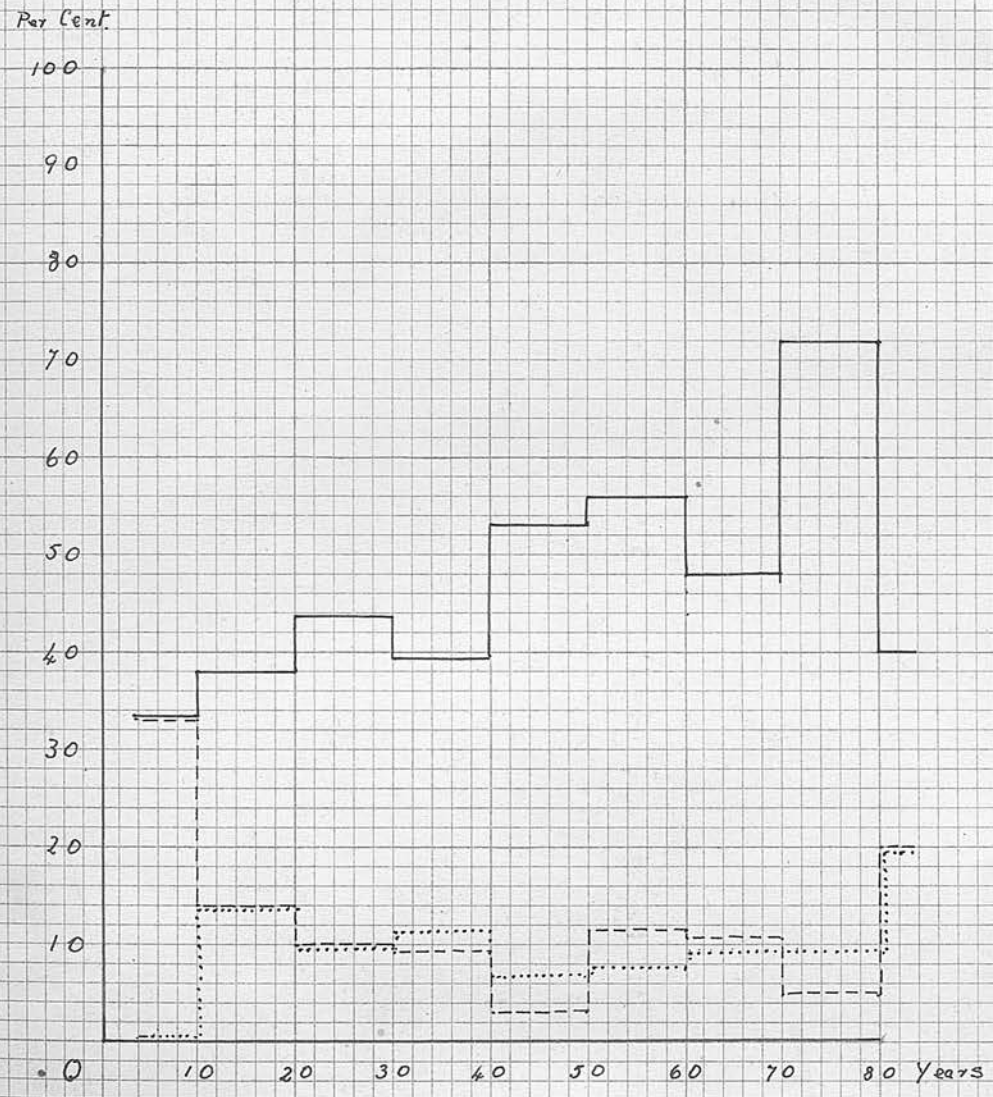
The lungs and bronchial glands, either alone or combined, were the most common sites. The mesenteric glands come next in order of prevalence and last to follow were the cervical groups. Small solitary calcareous nodules were occasionally found in the liver and spleen but never in the kidney. The size of calcareous nodes varied considerably from about 1/16 inch diameter, Sometimes a nest of calcareous granules little larger than coarse sand was met with. There were 193 cases with only calcareous lesions. We must accept them as healed tuberculous lesions, though not forgetting that Rabinovitch was able to inoculate successfully an animal from calcareous material. The youngest case to show a completely calcareous nodule was a female aged 4 years. Ghon's youngest case with calcareous deposit was aged 18 months. From table 4 it will be seen that the greatest number of cases with calcareous lesions occurred in the sixth decade. Graph 1 has been constructed from Table 3 and shows clearly the steady increase in the incidence of calcareous deposits in all individuals with advancing years. Of 22 cases

TABLE V

CHIEF PATHOLOGICAL DIVISIONS, FATAL CASES OF TUBERCULOSIS EXCLUDED.

AGES	TOTAL EXAM.	CALCA-RIOUS		LATENT CASEOUS		TOTAL ACTIVE		HEALED	TOTAL TUBERCULOSIS	
		No.	%	No.	%	No.	%	No.	No.	%
0-10	3	1	33	1	33	0	0	-	2	66
11-20	21	8	38	3	14	3	14	-	14	66.6
21-30	41	18	43.9	4	9.7	4	9.7	1	27	65.8
31-40	46	18	39	4	8.6	5	10.8	1	28	60
41-50	76	38	53	2	2.6	5	6.5	1	46	60
51-60	104	59	56.7	12	11.5	8	7.6	-	79	75
61-70	64	31	48	7	10.9	6	9	-	44	69
71-80	22	16	72.7	1	4.5	2	9	--	19	86
81+	5	2	40	1	20	1	20	-	4	80
AGE UNKNOWN	4	2	50	-	-	1	25		3	75
TOTAL	386	193	50	35	9	35	9	3	266	68.9

See Graphs 2,3 & 8.



GRAPH 2

FROM TABLE V

——— CALCAREOUS LESIONS

– – – – – LATENT CASEOUS "

..... TOTAL ACTIVE "

FATAL TUBERCULOSIS EXCLUDED.

in the 8th decade 16 or 72 per cent. showed the presence of calcareous material. Combining all ages the proportion with this lesion was 47.7 per cent. On the same graph were also plotted the figure for the caseous lesions. The 66 cases formed 16 per cent. of the total number examined. Again excluding the individuals over 80 years and under 10 years we find the greatest incidence in the 2nd decade, and then a more or less steady fall to the 8th decade. This runs conversely to the curve of calcareous cases. For completeness the incidence of the active cases was also plotted. This was the group which died of tubercle and had signs of activity but did not include the active caseous ones.

Table 5 and Graph 2 deal with all the cases in the series after those which died of tuberculosis have been excluded, and for that reason is more valuable and interesting. The 193 calcareous cases form 50 per cent. of the total and show the steady increase with age noted before. Those in which the caseation was encapsulated were grouped separately as latent, and the remaining caseous lesions with the four active cases formed the total active group. Each group consisted of 35 individuals or 9 per cent. of the whole. As there were only three cases under 10 years it was advisable to neglect them when working out the percentages.

GRAPH 3

FROM TABLE V

——— TOTAL TUBERCULOUS CASES

..... TOTAL ACTIVE CASES

FATAL TUBERCULOSIS EXCLUDED.

It will be seen that there is little variation in the occurrence of latent caseous cases. The next group of cases with active lesions was a purely arbitrary division as it was impossible to tell accurately from anatomical examination when a tuberculous lesion was active or when it was arrested. It was decided to be on the safe side and include amongst the active all lesions in which there was any dubiety as to their having been arrested. It is believed that the persons who have lesions included in this group of active disease are those who show symptoms of tuberculosis from time to time. Most of the lesions were comparatively small and localised, in fact consisted of a single nodule. Another significant point is that the original focus in the majority of the cases of miliary spread were similar to these caseous lesions. Therefore all cases of active or temporarily quiescent tubercle must be considered potential sources of further spread of the disease. The incidence of these cases is seen more clearly in Graph 3. The variation from 6 per cent. to 14 per cent. or if the five cases over 80 years be included to 20 per cent. is smaller than the other classes so far studied. The proportion closely corresponds to those in the latent case group. It will be inferred from this that little external influence will be required to alter the course of the disease from one class to the other. The age period with the lowest

incidence of active tubercle is just after the age period in which the tuberculous death rate is highest, namely 35 - 45; thereafter the incidence rises slightly though not comparable to the in - crease of calcareous deposits.

A small group of three cases classified as healed may be considered in greater detail. In these there were no signs of calcification or caseation to justify there being placed in other groups. The first case had a large cavity in one lung. The lining of the cavity was dry and of fibrous tissue with no sign of softening or activity. The other two cases were of cervical glands which had been removed by operation leaving only the cicatrix.

No. 443 - Male, 40 years; right lung, pleural adhesions; apical scar 2" x 2" x 1/16". Multilocular cavity in upper lobe about 2" diameter lined with fibrous tissue.

No. 7 - Male, 21 years; pleural adhesions and scar on anterior surface of right lung. Linear scar under right side of mandible as for excision of glands. Clinical history showed them to have been tuberculous.

No. 393 - Male, 48 years; lungs nil. Mesenteric glands enlarged and fibrosed. Scars over both sides of neck as for removal of glands. No glands seen at sectio.

Collecting the foregoing, we may subdivide non fatal cases as follows :

No signs of Tuberculosis -		120
Active Tuberculosis, except fatal cases -	35	
Calcareous Lesions -	193	
Latent Caseous Lesions -	35	
Healed Lesions -	3	
Total cases with Tuberculosis		266
Total cases examined, except fatal cases		386

The details are given in Table 5 from which the total positive and total active tuberculous have been plotted on Graph 3. Amongst the cases which do not suffer from a fatal tuberculosis 68.9 per cent. had tuberculous lesions of some sort. The incidence shows only a very slight fall from youth to the lowest limit in the fifth decade, namely 59%, and then it rises more rapidly to 86 per cent in the eighth decade. We shall see later that this corresponds with the drop in the incidence of glands and the rise in pulmonary lesions. 50.7 per cent.

TABLE VI

(1)

ANATOMICAL DISTRIBUTION.

Age Groups	Total Examined	Lungs		Lungs & Bron. Glands		Lungs, Bron. Mesenteric Glands		Bronchial Glands	
		No.	%	No.	%	No.	%	No.	%
0-10	4	-	-	-	-	-	-	-	
11-20	26	1	4	-	-	-	-	2	7
21-30	44	3	6	-	-	-	-	7	14
31-40	46	8	16	6	12	1	2	1	2
41-50	80	14	17	11	13	-	-	15	18
51-60	107	27	26	21	20	3	3	19	18
61-70	66	21	31	11	16	1	1	12	18
71-80	22	6	28	5	22	-	-	4	19
81 +	5	-	-	3	60	-	-	-	-
Age unknown	4	1	25	2	50	-	-	-	-
TOTAL	404	81	20	59	14	5	1.2	60	14.8
Less Fatal Tuberculosis	18	3		2		-	-	-	
	386	78		57		5		60	

TABLE VI (cont.) (2)

ANATOMICAL DISTRIBUTION

Age	Total	Mesenteric Glands		Mesenteric Glands & Lungs		General Tuberculosis		Mesenteric Kidney, Brain	Cervical Gland & Operation Scar	Cerv. Bron. Mes. Glands	Lungs Spleen
		No.	%	No.	%	No.	%	No.	No.	No.	No.
0-10	4	2	50	-		1	- 25				
11-20	26	10	38	-	-	5	19	1			
21-30	44	14	31	1	2	3	6		1		
31-40	46	7	15	1	2	-	-			2	
41-50	80	3	3	2	3	3	3		1	1	
51-60	107	3	2	2	2	2	2		1		
61-70	66	1	1	1	1	-	-				
71-80	22	2	2	1	5	-	-				1
81 +	5	-	-	-	-	-	-				
Age Unk.	4	-	-	-	-	-	-				
TOTAL	404	42	10.3	8	1.9	14	3.4	1	3	3	1
Less Pat. Tub.	18					13					
	386	42		8		1		1	3	2	1

See Table III for Fatal Tuberculosis Cases arranged in Groups. (Age)

TABLE VI (cont.) (3)

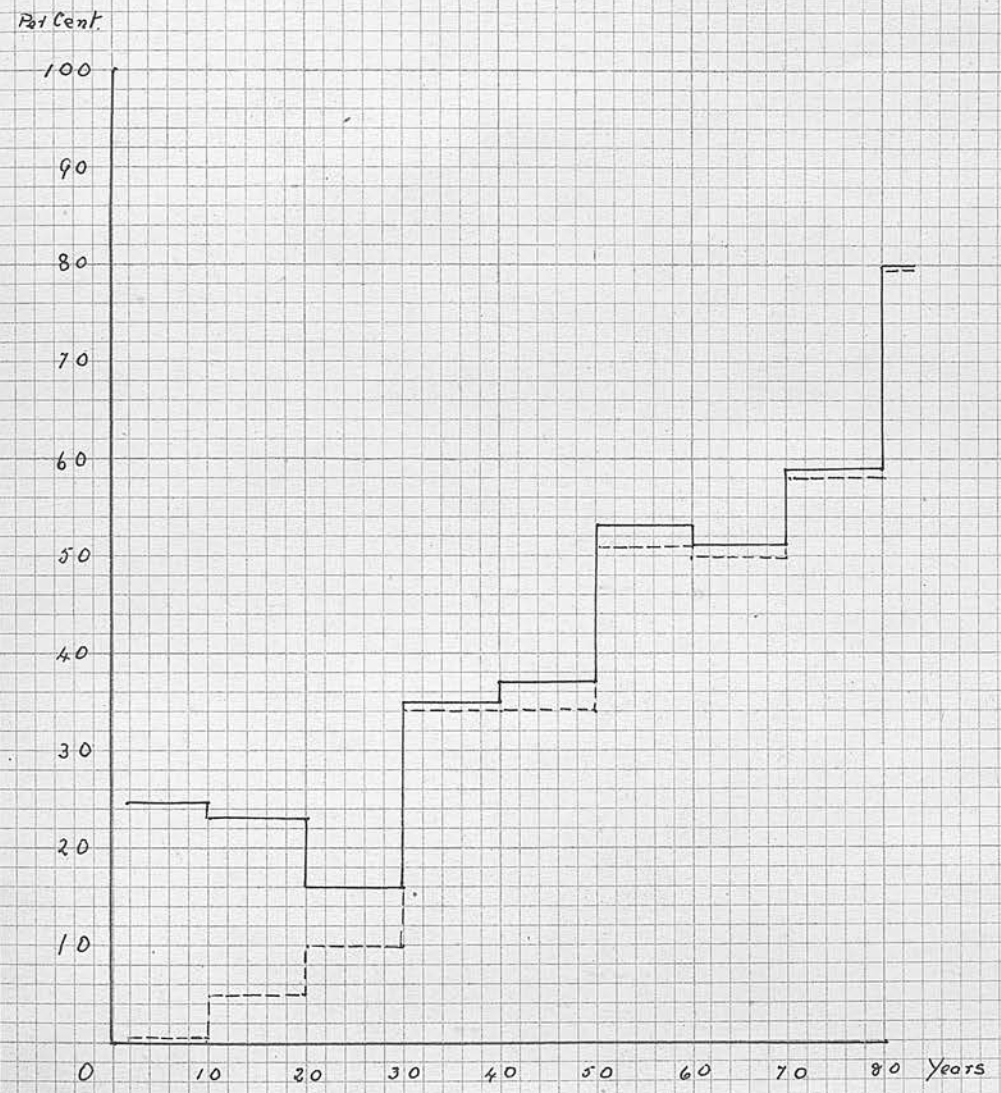
Age Groups	TOT. Ex.	Mesenteric Glands Kidney.	Lung Bron. Glands Spleen	Bronchial Mesenteric Glands	Cerv. Scar Lung Bron. Glands	Lung Kidney	Cerv. Mes. Glands	Total With Tuberculosis.	
		No.	No.	No.	No.	No.	No.	No.	%
0-10	4							3	75
11-20	26							19	73
21-30	44						1	30	68
31-40	46	2						28	61
41-50	80							50	62
51-60	107		1	1	1			81	75
61-70	66							47	71
71-80	22							19	86
81 +	5					1		4	80
Age unkn.	4							3	75
TOTAL	404	2	1	1	1	1	1	284	70.2
Less Fat. Tub.	18							18	
	386	2	1	1	1	1	1	266	68.9

T A B L E VII

CHIEF ANATOMICAL DIVISIONS

AGES	TOTAL EXAMINED	LUNGS TOTAL		GLANDS TOTAL	
		No.	%	No.	%
0-10	4	1	25	3	75
11-20	26	6	23	18	69
21-30	44	7	15.9	27	61
31-40	46	16	34.7	20	43
41-50	80	30	37.5	36	45
51-60	107	57	53.2	54	50
61-70	66	34	51.5	26	39
71-80	22	13	59	12	54
81 +	5	4	80	3	60
Age unknown	4	3	75	2	50
TOTAL :	404	171	42	201	49.7

See Graphs 4 & 7



GRAPH 4

——— TOTAL TUBERCULOUS LUNGS

– – – – – " " "

TABLE VII

FATAL TUBERCULOUS

EXCLUDED TABLE VIII.

of the cases had completely healed tuberculosis; in 9 per cent. the disease was inactive or arrested, and in a further 9 per cent. activity was present to a greater or less degree.

The anatomical distribution of the lesions will now be considered. Table 6 shows the different organs and combination of organs in which tubercle are found and the number of cases in which they were affected. (See also Table 7 and Graph 4). The lungs were most frequently affected without any other structure being involved. This occurred in 81 cases or 20 per cent. Only three of these cases were fatal. The total of lungs with and without other organs in the same body amounted to 171 or 42 per cent. After the 18 fatal cases were subtracted it was 153 or 39.6 per cent.

The state of the various tuberculous lesions in lungs when that pair of organs only was involved may be conveniently mentioned here.

Calcareous	52 cases	64%
Caseous	24 "	29 "
Active	4 "	4 "
Healed	1 "	1 "

Three of the four active cases were fatal. Of the caseous cases 9 were active and 15 latent inactive, that is, completely encapsulated.

The next most common organs to be infected were

the bronchial lymph glands, namely 60 cases or 15 per cent. Amongst these adult cases, none died of active tuberculosis. This is in strong contra-distinction to what happens in children, where as Mac-gregor has pointed out in her series, death invariably supervened.

The lungs and superficial glands were simultaneously affected in the same patient 59 times or 14 per cent. Two of these were fatal. The combination of lung, bronchial and mesenteric glands occurred five times, and that of cervical, bronchial and mesenteric glands thrice. The latter grouping occurs much more frequently in children usually with unhappy results. In this series the ages were from 31 to 50 and the condition was calcareous in two and caseous in one. The bronchial glands were infected altogether in 144 cases less 15 fatal cases.

The majority of the lesions in the glands were calcareous, and the balance were caseous, completely or partially encapsulated. The size varied from small spicules of calcified material only found after cutting through the glands in sections, to nodes one inch in diameter and irregular in shape. The glands involved were those chiefly round the main bronchi and at the bifurcation of the trachea, in fact the gland just under the bifurcation was most frequently affected and sometimes had increased to a considerable size when it pressed on the walls of the tubes. The

glands along the trachea and larger and medium bronchi were also involved though less frequently. The right side showed a slight preponderance in frequency over the left. The percentage increased from youth up to 40 years and then kept at a fairly high level. In the case of bronchial glands only the maximum was 19 per cent. at 40-50 years, but for bronchial glands associated with lesions in other organs the figure for the same period was 30 per cent., and during the three succeeding decades it averaged 40 per cent. This shows that the bronchial glands become infected during adult life without the lungs being simultaneously involved in every case. There is also a strong tendency to self cure in these organs as shown by the number of localised calcareous lesions. In this series it was not till after 30 years of age that other organs were affected with the bronchial glands in the same cadaver to any marked extent. The lungs were the organs chiefly associated in these cases. There was no constant relation between the size of the lesions in the two organs. In many of the cases there did not appear to be any anatomical grounds for believing them to be in the same area of the lymphatic system.

In passing to the consideration of the next most common group of glands - the mesenteric - to be involved, we find that the highest incidence is in the first decade. As this curve commences at a higher level and earlier in life than that of the other groups, it will be advisable to review them generally at this point.

TABLE VIII

CHIEF ANATOMICAL DIVISIONS, FATAL CASES OF TUBERCULOSIS EXCLUDED.

AGES	TOTAL EXAMINED	LUNGS TOTAL		GLANDS TOTAL	
		No.	%	No.	%
0-10	3	0	0	2	66
11-20	21	1	4.7	13	61.9
21-30	41	4	9.7	24	58.5
31-40	46-	16	34.7	20	43
41-50	76	26	34	33	43
51-60	104	54	51.9	51	49
61-70	64	32	50	26	40.6
71-80	22	13	59	12	54.5
81 +	5	4	80	3	60
Age unknown	4	3	75	2	50
TOTAL :	386	153	39.6	186	48

See Graphs 4 & 7

TABLE IX

Age	Tot. Exam.	TOTAL TUBER-CULOSIS	TOTAL BRONCHIAL GLANDS		BRONCHIAL GLANDS ONLY		TOTAL MESENTERIC GLANDS		MESENTERIC GLANDS ONLY	
			No.	%	No.	%	No.	%	No.	%
0-10	3	2	-	-	-	-	2	66	2	66
11-20	21	14	2	9	2	9	11	52	10	47
21-30	41	27	7	17	7	17	16	39	14	34
31-40	46	28	10	21	1	2	13	28	7	15
41-50	76	46	27	35	15	19	6	7	3	3.9
51-60	104	79	45	43	19	18	10	9	3	2.8
61-70	64	44	24	37	12	18	3	4	1	1
71-80	22	19	9	40	4	18	3	13	2	9
81 +	5	4	3	60						
Age Unknown	4	3	2	50						
TOTAL	386	266	139	36	60	15	64	16	42	10

See Graphs 5 & 6

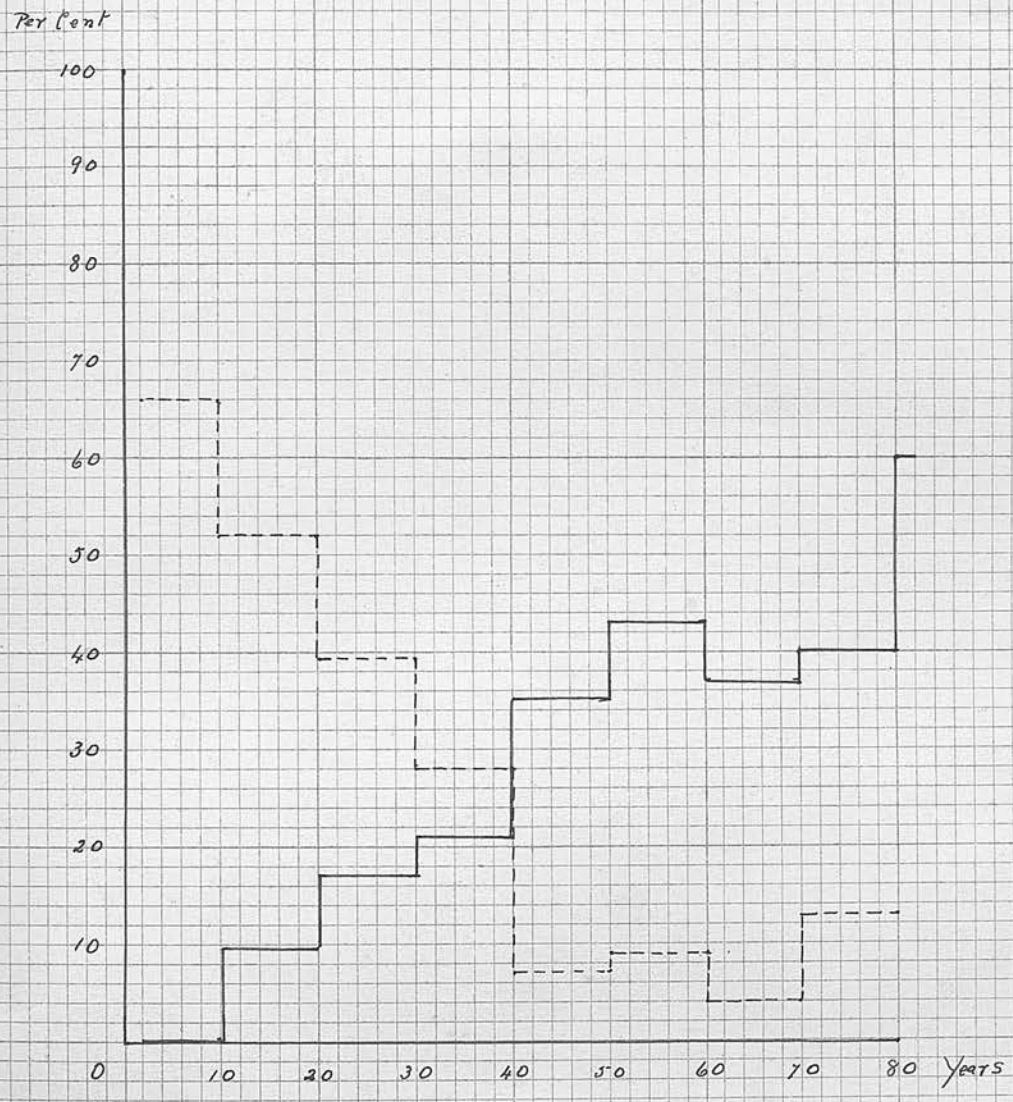
Fatal cases of Tuberculosis excluded

GRAPH 5

FROM TABLE IX

_____ TUBERCULOUS BRONCHIAL GLANDS ONLY

_ _ _ _ _ TUBERCULOUS MESENTERIC GLANDS ONLY.

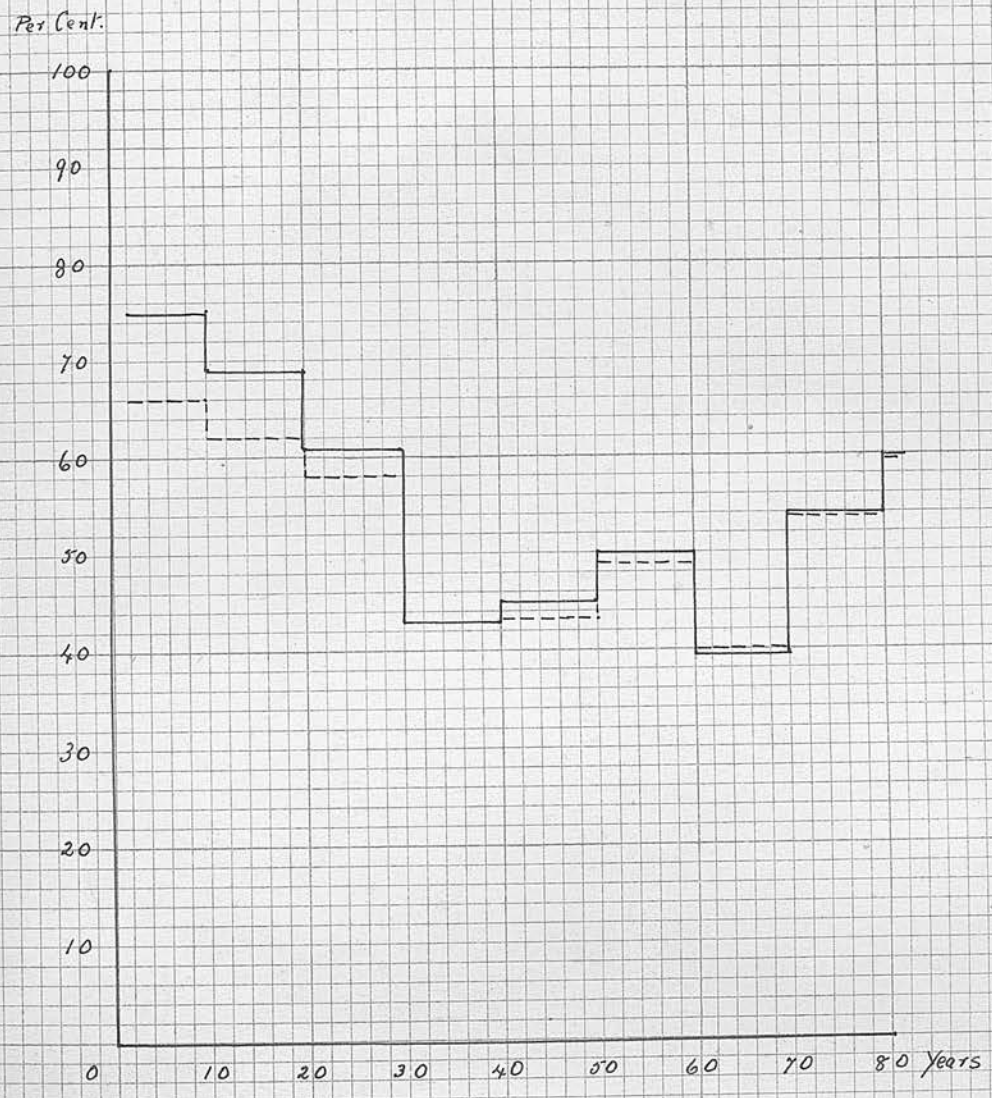


GRAPH 6

FROM TABLE IX

——— TOTAL TUBERCULOUS BRONCHIAL GLANDS

– – – – – TOTAL TUBERCULOUS MESENTERIC GLANDS



GRAPH 7

_____ TOTAL TUBERCULOUS GLANDS TABLE VII

_ _ _ _ TOTAL TUBERCULOUS GLANDS, FATAL TUBERCULOSIS EXCLUDED TABLE VIII

We must first examine the graph showing the total incidence of tuberculosis at all ages. It commences at 66 per cent. and remains about that level, but showing a slight tendency to drop, till 50 years of age, when it starts to rise. As infants are not born tuberculous but acquire the disease usually after six months of age the figure 66 per cent. represents an average taken over the first ten years. The curve starts from zero. To understand this curve the figures which are used to build it up must be analysed. The first main division is that of the total glands as shown in Graph 7. Starting at the same level as the previous curve it soon commences to drop and reaches a minimum of about 42 per cent. which is maintained throughout the period 30 to 50 years, after which there is a slight rise. Returning to Graph 4 which shows the incidence of pulmonary lesions, we see that from an almost negligible quantity during the first two decades it then commences to rise and continues to do so till old age is reached. The marked increase of pulmonary disease in adult life has a distinct influence on the total curve completely counteracting the drop of the glandular cases and not only keeping the total tuberculosis curves at its original level but causing it to rise in later life.

The explanation of the behaviour of the glandular curve will be found from an examination of the curves relating to the constituent groups of glands, namely, the bronchial and mesenteric glands - (Graphs 5 & 6).

The mesenteric glands are at the high level of 66 per cent. during the first decennium and then drop steadily to about 8 per cent. in the fifth decennium about which level they remain till the end. The maximum point of this curve occurring during the first ten years indicates that there is an early and heavy tuberculisation occurring by way of the abdominal lymph glands. The subsequent fall of the incidence in these glands requires careful consideration. The possible explanation of this remarkable fall in the incidence of abdominal tuberculosis as opposed to the rises manifested by other forms are as follows :

(1) It might be due to a steady increase of the incidence of abdominal tuberculosis during the past forty years. This is not borne out by death statistics nor by clinical records, in fact the tendency is in the reverse direction. Shennan showed only a slight reduction in this form of the disease between his two periods of observations (1886-1902 as compared with 1910-1913).

(2) Those individuals who carried tuberculous mesenteric glands might have been removed from the population by death.

On this hypothesis one must assume that there is a definite correlation between tuberculous infection of the mesenteric glands and the chance of death of the individual thus affected. That is to say, all such individuals must possess an increased susceptibility to disease in general and to tuberculosis in particular. This susceptibility might be due to an inherent

tendency to disease or to social or environmental conditions, such as overcrowding, lack of sunlight, etc.

The drop in the percentage of mesenteric glands might thus be explained but this would imply that the percentage (50%) of children under 10 years of age with mesenteric glands is higher than what would be found in the surviving population as it represents the proportion in a selected group in which the incidence of fatal diseases is higher than in the surviving remainder. According to this view the reduction would be due to the disappearance of a fraction of the population which is unduly susceptible and which is consequently selected by death. On the other hand the fact that the bronchial curve rises implies that the curve as shown is more representative of the general population, as beyond the age of 80 there are practically no survivors.

If this hypothesis be accepted one must suppose that within the area supplying the Edinburgh hospitals there are located various colonies or nests of these highly selected individuals: that the inhabitants of these nests will supply the cases with tuberculous abdominal lesions, and that the majority will die before reaching 50 years of age: that the pulmonary and bronchial cases which are the most numerous class will be derived from the general population as well as from the nests in question. Thus, tuberculosis would have to be divided into two distinct types, the mesenteric

type with its correlated high susceptibility to disease in general and consequently to early death and the bronchial and pulmonary type whose selective characteristics are of a much lower level.

Further light may be thrown on the question by studying only cases of deaths from accidents. There were 29 of these in the total series. A large proportion occurred in coal mines, several in the streets, and burns and scalds accounted for most of the remainder. Eighteen of these cases had tuberculous lesions, which forms a percentage (66) very similar to that found in the total population (69%) Now most of these cases occurred in adults who harbour tubercle in the lungs or bronchial glands, so that one must conclude that the percentage of tuberculosis in those who died must approximate very closely to the amount of tuberculosis in those who survived.

Taking also into account the fact that abdominal tuberculosis is not usually a fatal disease, one is forced to conclude that this method of explanation is untenable.

(3) The fall in the curve might be attributed to the disappearance of the lesions in the individual. In this series of 64 cases, 46 were calcareous, 17 were caseous and 1 was in the early active stage of infiltration. (The last belongs to the type which may clear up without leaving any trace beyond perhaps some fibrous

scar tissue, if it does not advance to caseation.) The size of the nodules varied and also the number present in each case was not constant. Quite a number did not exceed $\frac{1}{4}$ inch in diameter; sometimes two or three clusters of these small nodules occurred together. Glands $\frac{1}{2}$ inch in diameter were numerous and frequently multiple, calcareous nodes of $\frac{3}{4}$ inch and 1 inch or more were more usually single and were not always of spherical outline. All glands had some sort of connective tissue envelope enclosing them in the mesentery. The two usual sites were near the ileo-caecal region and in the centre of the mesentery towards its root. Glands up to $\frac{1}{4}$ inch diameter were grouped as small, those about $\frac{1}{2}$ inch as medium, and from $\frac{3}{4}$ inch upwards as large.

Calcareous	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Large	1	4	4	3	-	-	-	1
Medium	-	-	5	2	2	2	-	1
Small	-	2	2	2	1	1	-	-
Caseous								
Large	1	1	2	-	-	-	-	-
Medium	-	1	1	-	-	-	1 active	-
Small	-	1	1	-	-	-	-	-

There is no definite correlation between the size of the lesions amd the age of the subject. The classification is of course very rough as some of the smaller lesions are frequently multiple and all the

lesions in one abdomen are not of the same size. The relation between the size of the glands and the size of the cadaver was not noted . Perhaps the best method would have been to weigh the pathological tissue. The above are the cases with abdominal lesions only, the other cases were excluded as in some the size of the lesion had not been noted.

When the mesenteric glands alone or along with other lesions are themselves only classified as calcareous or caseous there is a steady increase.in the proportion of calcareous lesions from 50 per cent. at the age of 0-10 years to 92 per cent. at ages 31-40 years, afterwards it is a little irregular.

	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Calcareous	1	7	13	12	4	8	1	3
Caseous	1	4	4	1	2	1	1	0
Total	2	11	17	13	6	9	2	3
Percentage of Calcareous	50	63	75	92	66	88	50	100%

In the laboratory these calcium salts can only be dissolved by strong acids, but it does not follow that the same process must occur in the body. Although the reaction of the blood is faintly alkaline there are a number of acids such as carbonic acid which are capable of carrying out chemical reactions in such weak dilutions with the aid of enzymes, which are also present in the blood.

Calcareous glands are foreign bodies and are treated as such. The body always tries to get rid of such dead material by phagocytosis or lysis. In this case the material is extravascular and usually enclosed in a avascular envelope, so that phagocytosis could have little influence. The other alternative is that a slow solution occurs by the aid of the ferments which are normally present in the lymph. The process is bound to be very slow extending over many years, and in some cases it is never completed as is indicated in the figures for ages over 40 years. Perhaps the phagocytic cells assist by removing the débris after it has been loosened and sufficiently broken down by chemical action.

This process then must be the explanation of the steady and rapid fall of the curve referring to mesenteric gland lesions. Probably a similar reduction occurs in bronchial gland lesions, though it is not shown in the charts on account of the continued and increasing incidence of these lesions. It is possible however that in the reduced metabolic activity of higher ages there is also a reduced rate of removal of these lesions.

To recapitulate, we find that the high incidence of healed tuberculosis in infancy is due to the mesenteric glands. These do not show any <u>marked</u> tendency to become infected in later years, but the tubercles undergo a process of disintegration and

final disappearance from the body. In early childhood and adolescence the bronchial glands develop lesions, or it would be more correct to say that they allow the tubercle to develop, but they have by this time sufficient antigenic ppwers to inhibit the growth and eventually to completely arrest it. We know that the bronchial glands in infants are also affected but the disease is progressive and terminates in a miliary dissemination. In adolescence and young adult life the lungs become more numerously infected, so that they form the largest class of tuberculous disease.

In spite of the disappearance of mesenteric gland tubercle the incidence of the disease in the years after infancy is maintained at a fairly constant level till mid life by the accession of other tuberculosed organs. After mid life there is another rise in the curve of all forms due chiefly to advance in the lungs. If all cases of tuberculosis had been admitted, including those dying of the disease, the graphs would have been different.

In infancy and early childhood we should have added the large number of deaths from miliary and meningeal types and again in the first half of adult life would have occurred the fatal cases of the pulmonary forms. Our present figures show the distribution of the cases of healed tuberculosis. In fact the curves may be interpreted as showing the index of resistance of the individual in the different age groups to the particu-

type of tuberculosis.

LESS FREQUENT MANIFESTATIONS OF TUBERCULOSIS.

Cases illustrating the less frequently infected organs will now be examined. They all have a primary focus in the bronchial or mesenteric glands or the lungs.

KIDNEY

The kidney will be dealt with first of all. Two of the fatal cases of tuberculosis are of interest in respect to their kidneys. Both had active tubercles in the kidneys associated with perinephritic absceses. In one no older lesion was discovered and death was actually due to the kidney lesions. The other case had also an old pulmonary cavity and death was apparently due to a recent tuberculous broncho-pneumonia.

382 - male, 46 years. Left kidney contained large multiple tubercles and abscesses. Numerous caseous foci and giant cells were seen on histological examination. There was a large perinephritic abscess from which tubercle bacilli and streptococci were isolated. The right kidney contained a few early tubercles and abscesses. Both ureters were dilated and the bladder showed considerable tuberculous ulceration. Both lungs contained numerous small abscesses. The spleen was speckled with numerous almost microscopic tubercles, whose condition was confirmed histologically.

135 - female, 41 years. Both lungs contained tuberculous broncho-pneumonia, and their regional lymph glands were extremely caseated; in addition there was a large cavity in the right lung. The left kidney had calcareous deposits in the pelvis and caseous masses at both poles. There was a considerable perinephritic abscess. There were some small calcareous spicules in the spleen.

The majority of the cases of miliary tuberculosis showed tubercles on the kidneys as part of the general infection but apart from those and the two just quoted four other cases were seen.

439 - male, 88 years. Cause of death: acute intestinal obstruction. Left lung: several calcareous spicules in the apex, firm fibrous scar at apex 2"× 1"× ¼" deep. Right lung clear. Left kidney; near centre of cortex caseous mass ¾ inch diameter surrounded by fibrous tissue.

450 - male, 39 years. Cause of death; neoplasm of right lung and mediastinum. Lymph gland close to caecum and overlying right ureter calcified and ½ inch diameter. In the left kidney cortex close to the periphery, a yellow caseous mass 1/8"× 1/8"× ¼".

32 - male, 32 years. Cause of death: sub-acute intestinal obstruction. Lungs and thoracic glands clear of tubercle. Group of 3 or 4 calcareous glands in the abdomen close to pancreas, about ¼ inch diameter. Each kidney contained a yellow caseous nodule about 1/8" diameter situated in the medulla close to the pelvis.

61 - female, 13 years. Cause of death: tumour of cerebellum. Caseous mesenteric glands. Several miliary tubercles in the kidneys. Lungs and other lymphatic glands clear.

These four cases, ages from 13 to 88 years, showed the presence of tubercles in the kidneys associated with lesions in other organs. The kidney lesions were in every case caseous and only one had a complete fibrous capsule, namely, the old man with the calcification in the lung. In the other three the tubercle was without any limiting structure and presumably emitting toxins; in other words they were quietly active. Nos. 450 and 32 - middle aged males - had calcified abdominal glands of distinct size and then comparatively recent caseous nodules in the kidney. So there were three cases with healed calcareous lesions in various organs associated with caseation of the kidney. The last case had distinct

active caseation of the mesenteric glands and small pin head tubercles in the kidneys. The size of the cerebellar tumour occasioned death in her case. Few though the numbers be, the clinical experience is confirmed that tuberculosis occurs in the kidneys without any lesion being discoverable elsewhere. It would have been impossible to diagnose the presence of these calcareous nodes by physical signs; in the lungs they were far too small and the abdominal ones also were small and much too deeply located. It is doubtful if the X rays would be able to show them up. Early renal tuberculosis must therefore be diagnosed by its symptomatology aided by the special surgical methods. In none of the 404 cases was a calcareous or otherwise healed tubercle found in the kidney. The nearest approach to arrest was the man of 88 with a large caseous mass encapsulated by fibrous tissue. The incidence of tuberculosis of the kidneys works out at 4 cases in 386 or 1 per cent. of all active or latent active.

Caseous tubercles of the kidney in adults with only old calcareous deposits elsewhere raises the debatable question of re-infection in tuberculosis. The fourth case occurring at a very receptive age for tubercle with caseation elsewhere, may be excluded at present. If one were to judge from these cases alone, the decision would be in favour of re-infection from

an external source, as it is difficult to understand how the bacilli could free themselves from the calcareous glands without the aid of a great mechanical disturbance. The number of cases is, however, too small for a decision to be reached.

SPLEEN.

The spleen was found to be affected in only two instances in the 386 cases. Both were in adults over middle age with a small calcareous node in the spleen.

No. 130 - female, 74 years. Left lung; apical scar 2" × ½" × ¾" on microscopic examination consisting of fibrous tissue with numerous blood vessels, granules of carbon scattered about, and several groups of lymphocytes. Calcareous deposits in lower lobe ¼" diameter. The spleen had one calcareous deposit 1/8" diameter.

No. 207 - male, 54 years. Right lung; apical scar. Tracheo-bronchial gland calcareous ½" diameter and also a broncho-pulmonary gland ½" diameter. Left lung completely adherent to chest wall. There was a calcareous plaque 5" × 2½" × ¼" thick lying between the lung and the axillary wall of the thorax and

enclosing some caseous material. It looked like the remnant of an old empyema. One broncho-pulmonary gland was calcareous ¼" diameter. Spleen also had a calcareous nodule 1/8" diameter.

Apart from cases with generalised tuberculosis the liver was not involved.

It will be clearer if the commoner sites of lesions are tabulated.

	No.	% of tot.	less fatal cases	No. less fatal	% of ex-fatal
Lungs :	81	20	3	78	20
Bronchial Glands	60	14.8	-	60	15
Lungs & Bron. G.	59	14.	2	57	14.7
Mesenteric Gl.	42	10.3	-	42	10.8

The above figures emphasise the importance of looking for tubercle in these regions when examining any patient with a view to tuberculosis.

CERVICAL GLANDS.

It will be remembered that several of the adults who died of tuberculosis had tuberculosis of the cervical glands. In children they are frequently infected, so during the present investigation a special search was made for diseased cervical glands. Evidence of previous infection was found in 8 of the 386 cases, that is in 2 per cent. Two cases showed operation cicatrices following excision of cervical glands without any glands being left.

No. 393 - male, 48 years. Operation scars over right cervical glands. Mesenteric gland enlarged and fibrosed.

No. 7 - female, 21 years. Scar under right side of jaw for excision of tuberculous glands. Left lung; fibrosed Area on pleura $\frac{1}{4}$" diameter.

Four cases had caseous cervical glands. In the one there had been considerable discharge for long periods judging by the state of the old sinuses. The other was of the youthful type of the disease, which was noticed by several Allied pathologists among the Colonial Troops, namely, caseation of cervical, thoracic and abdominal glands.

No. 219 - female, 53 years. Remains of old sinuses on both sides of neck with caseous and fibrosed glands beneath several of the scars. In the upper lobe of the right lung was a large area of fibrous tissue joining the lung to the parietal pleura and sending roots into the lung substance for about 1½ inches.

No. 42 - female, 45 years. Cervical, bronchial and mesenteric glands all at approximately at the same stage of caseation without any calcification. No lesions of a tuberculous nature in other organs.

The remaining four of the series had calcareous cervical glands with other manifestations elsewhere.

No. 218 - female, 32 years. Calcified gland enclosed in fibrous tissue under the left half of the mandible, with operation cicatrix immediately superficial to it. Calcareous spicules in tracheo-bronchial glands, more numerous on left side than right. One calcareous mesenteric gland.

No. 252 - male, 37 years. Left cervical gland close to mastoid process calcareous 1" × ½" × ½". Calcareous spicules in

in right and left broncho-pulmonary glands. Calcareous glands ¼" diameter in mesentery close to ileo-caecal junction. Scar tissue in pleurae.

No. 360 - female, 51 years. Left side of neck, two parallel scars and closely subjacent was a calcareous gland ½" × ¼" × ¼" enveloped by fibrous tissue. There was another calcareous gland just above the aortic opening in the diaphragm. Calcareous node ¾" × 1/8" × 1/8" in anterior free margin of lower lobe of left lung.

No. 45 - female, 22 years. Left submental glands calcareous about ¼" diameter. Calcareous mesenteric gland ¾" × ½" × ⅛" near caecum. Several small calcareous retro-peritoneal glands.

BONES and JOINTS.

Two cases occurred with active tuberculosis of bone and joint, and both terminated by the spread of the infection throughout the lungs and meninges while under treatment for the bone and joint condition.

79 - female, 15 years. Tuberculous left hip joint of three months duration. Symptoms of meningitis developed two weeks before death and those of broncho-pneumonia day before death. Tuberculous meningitis with diffuse early miliary tubercles in both lungs more numerous in the upper lobes. One third of the left upper lobe was consolidated with early tuberculous broncho-pnenmonia 2" below apex on its anterior surface caseous node $\frac{1}{4}$ inch in diameter.

168 - male, 14 years. Tonsils, pharyngeal and paratracheal glands enlarged and tuberculous. Both lungs scattered small miliary tubercles. Mesenteric glands enlarged almost caseous, spleen one small tubercle, larynx, two tubercles above cords on either side. Lower end of right tibia tuberculous periostitis which had recently been treated surgically.

IS THERE ANY RELATION BETWEEN THE OCCURRENCE OF TUBERCULOSIS IN THE LUNGS AND THE TRACHEO-BRONCHIAL GLANDS ?

Parrot's law states that no lesion occurs in the lungs without a corresponding one in the regional lymph glands and vice-versa that no change occurs in the tracheo-bronchial glands without analogous ones in the lungs.

Numerous observers have noticed since then that tuberculosis occurs in the lungs without lesions in the glands and vice-versa, so that considerable doubt has been thrown on the veracity of Parrot's statement. In the present investigation the lungs alone are affected 61 times, the bronchial glands alone 60 times, and the lungs and bronchial glands together in 59 cases. As sufficient figures were available it was sought to examine the problem mathematically. Following the method accepted for dealing with groupings of this sort I used Pearson's relation :

$$\chi^2 = \frac{N\,(ad - bc)^2}{(a+b)(c+d)\,(a+c)\,(b+d)}$$

where N = the total number of observations

a+b+c+d = total number of cases to be investigated viz. 404

0 = No pathological lesion present in that anatomical site.

\+ = A pathological lesion present in that anatomical site.

The significance of the symbols a,b,c,d, is shewn

on the following schema ;

2nd anatomical part e.g. bronchial glands \ 1st anatomical part e.g. lung	o	+
o	a	b	a+b
+	c	d	c+d
	a + c	b+d	a+b+c+d

The correlation between lungs and all lymph glands was first worked out.

LUNGS

All glands	0	+	
0	120	83	203
+	113	88	211
	233	171	404

$\chi^2 = .3466$ P ≒ .9

Where P is the probability that the two attributes are independent of each other. The high value of P indicates a high degree of independence, that is to say there is no association between lesions in the lungs and lesions in any of the lymph glands in the body, nor is there a negative relation between them.

The correlation between Lungs & Bronchial Glands.

LUNGS

Bronchial Glands	0	+	
0	169	91	260
+	64	80	144
	233	171	404

$-\chi^2 = 16.04$ P = .0011

The low value of P means that the chances of the two

lesions occurring at random are about 1 in 1000, that is to say there is a definite association between the occurrence of tuberculosis in the lungs and in the associated tracheo-bronchial lymph glands.

The correlation between lungs and mesenteric glands:

		Lungs 0	Lungs +	
Mesenteric Glands	0	183	144	327
	+	50	27	77
		233	171	404

$\chi^2 =$ 2.02 P $\doteq$ .57

This indicates that there is neither a positive nor a negative association between lung and mesenteric gland tuberculosis.

The correlation between Bronchial Glands and Mesenteric Glands:

		Bronchial Glands 0	Bronchial Glands +	
Mesenteric Glands	0	207	120	327
	+	54	23	77
		261	143	404

$\chi^2 =$ 1.27 P $\doteq$ .8

Here again there is neither positive nor negative association between these two groups of glands.

The facts obtained from the above calculations are :-

1. That a definite relationship exists between the occurrence of tuberculosis in the lungs and in the

tracheo-bronchial glands.

2. That tuberculosis in the lungs, the glandular system as a whole, in the mesenteric glands and bronchial glands occurs independently in each system or group of glands except as mentioned in the foregoing.

3. and that so far as the figures show there is no evidence that the appearance of tuberculosis in one group of glands produces an immunity which protects the remainder of the body as no negative association has been found.

THE RELATION OF ANTHRACOSIS AND TUBERCULOSIS.

Twenty-eight cases presented anthracosis and in twenty-six it was so marked as to render the lung completely black and gritty on cutting. The microscopic examination even of the blackest specimens showed that the carbon was distributed as isolated granules in the intestinal tissue and alveolar cells, but leaving a large amount of lung tissue for carrying on its functions. Not all the carbon was contained within the interstitial tissue and alveolar cells; there was a certain amount lying in the alveolar spaces, and in the parts of the lung which were not so intensely laden with carbon it could be seen in many instances within phagocytic cells lying in the alveoli; this was a common appearance in some lungs which contained hardly any pigment in the stroma.

Eleven of these cases, chiefly coal-miners, showed signs of tuberculosis of the lungs. The ages extended from 29 to 71. Three of the lesions were caseous, two being apparently active and one enclosed by fibrous tissue and therefore latent inactive, none of them was more than $\frac{1}{4}$" diameter. Two cases died of extensive pulmonary tuberculosis. In six there were one or two calcareous nodes in one or both lungs, and the nodes were not larger than $\frac{1}{4}$" diameter, and of the cases in which two nodes were present they were in separate

lobes in one case and in separate apices in the other. One case with a calcareous node in the left apex showed a similar and larger calcareous node in its corresponding root gland.

The following list includes the anthracotic cases with tuberculous lesions in the lungs, all were coal-miners except 81, a moulder, and No. 20, a coal carter. The cause of death is noted in each case.

No. 19 - male, 35 years, right apex, caseous node, size of pinhead. Ulcerative endocarditis with chronic mitral endocarditis and stenosis. Marked chronic venous congestion.

No. 29 - male, 50 years, right upper lobe calcareous node 1/8th inch diameter. Both apices thick scar tissue. Carcinoma of Pylorus.

No. 68 - male, fibrous and calcareous nodules in right upper lobe $\frac{3}{4}$" diameter. Fractured vertebrae.

No. 81 - male, 51 years, right upper lobe caseous nodule enclosed by fibrous tissue $\frac{1}{4}$" diameter with marked fibrosis of pleura and lung $1\frac{1}{2}$ x $\frac{1}{2}$" x$\frac{3}{4}$" deep.

No. 99 - male, 47 years, calcareous node 1/8th - $\frac{1}{4}$" diameter in each upper lobe. Lysol poisoning.

No. 163 - male, 67 years, pulmonary tuberculosis causing death.

No. 245 - male, 29 years, chronic glandular and pulmonary tuberculosis, acute meningeal tuberculosis.

No. 390 - male, 47 years, left upper lobe and left root gland, calcareous nodes $\frac{1}{4}$" and $\frac{1}{2}$" diameter. Acute ulcerative colitis and peritonitis.

No. 411 - male, 54 years, left lower lobe, upper surface calcareous gravel. Compound fracture right femur, shock.

No. 420 - male, 63 years, left upper lobe calcareous nodules. Carcinoma of Prostate.

No. 5 - male, 71 years, right apex caseous and calcareous area about $\frac{1}{4}$" diameter. Chronic Intestitial Myocarditis.

Four cases of miners with ages from 44 to 52 years had no tuberculosis of the lungs but calcareous deposits up to $\frac{1}{4}$ inch diameter in the tracheo-bronchial glands. Another case contained no tuberculosis in the thoracic organs but two calcareous glands each $\frac{3}{4}$" diameter in the mesentery.

No. 100 - male, 52 years, calcareous granules in right tracheo-bronchial glands. Double Empyema.

No. 181 - male, 44 years, calcareous bronchial gland $\frac{1}{4}$" diameter. Acute peritonitis.

No. 332 - male, 58 years, left broncho-pulmonary gland calcareous spicules. Fibrous nodes in both apices. Lobar pneumonia.

No. 407 - male, 46 years, tracheal bifurcation gland, calcareous spicules. Post operative shock.

No. 377 - male, 34 years, 2 calcareous glands, $\frac{3}{4}$" diameter, in mesentery. Fracture-dislocation of spine.

There were 12 cases of anthracosis, very well marked in 10 and only slight in 2, in which no tuberculosis was found in any part of the body. One case was a rubber worker, another was a labourer and the remainder were miners. Scars on the lungs were noted six times and adhesions four times. The causes of death were various acute and chronic diseases and accidents. There were no other relevant points of interest about the cases. The ages were as follows :- 22, 27, 38, 45, 49, 54, 54, 57, 62, 65, 65, 68.

Out of 28 cases 11 (39%) had tuberculosis of the lungs, 5 (17%) had tuberculosis of glands and 12 (42%) were non tuberculous. Four of the tuberculous cases or 14% showed signs of activity. When the two fatal cases are deducted, 9(34%) had tuberculous lungs, 5(19%) had tuberculosis of glands and 12 (46%) were non-tuberculous.

TABLE A.

	General Cases 404		Anthracosis 28	
1.	Number and % of positive cases 284	70%	16	57%
2.	Number & % of cases with tuberculosis of lungs. :.....171	42.3%	11	39%
3.	Number & % of cases with tuberculosis of glands 201	49.7%	7	25%
4.	Number & % of cases with signs of activity .. 53	13%	4	14%
5.	Number & % of active cases of the positive cases (of 284).....53	18% (of 16)	4	25%
6.	Number & % of cases dead of tuberculosis 18	4.4%	2	7%

TABLE B.

		General cases less those dead of Tuberculosis. 386		Anthracotic ditto. 26	Cases
1.	Number & % of positive cases	266	68.9%	14	54%
2.	Number & % of cases with Tuberculosis of lungs	153	39.6%	9	34%
3.	Number & % of cases with Tuberculosis of glands	186	48%	6	23%
4.	Number & % of cases with signs of activity	35	9%	2	7%
5.	Number & % of active cases of the positive cases (266) .	35	13% (of 14)	2	14%

Taking a broad view of the figures it will be seen that the percentage of tuberculous subjects in the anthracotic group is less than in the general population. On analysis of the cases it is seen that those with tuberculosis of the glands show a greater diminution than those with tuberculosis of the lungs. In fact in the total series the proportion of glands involved is higher than of lungs, while the reverse holds good for the anthracosis series. In respect of the low incidence of glandular involvement two facts must be considered. Firstly, the number of glandular cases is small and the possible percentage error therefore high. Secondly, it is possible that men who have suffered from extensive glandular tuberculosis

in youth will not choose to become miners.

When the different pathological states are considered we get the following table :-

	General Series No.	%	Anthracosis Series No.	%
TABLE C	386		26	
Total Tuberculosis	226	68.9	14	54
Calcareous	193	50	11	42.5
Healed	3	-	-	-
Caseous (latent)	35	9	1	3.5
Active	35	9	2	7

It will be observed that each type in the anthracosis series has a lower incidence than in the total series. The biggest reduction occurs in the calcareous division, and the least is in the active, whereas the active cases are proportionately almost equal in the two groups.

CONCERNING CHRONIC VENOUS CONGESTION AND TUBERCULOSIS.

Nine cases of mitral stenosis and chronic venous congestion occurred in the 404 post-mortems, that is in 2 per cent. The details of the cases will be given first.

No. 19 - male, 36 years; ulcerative endocarditis, chronic endocarditis and stenosis of mitral valve. Chronic venous congestion. Anthracosis. Right apex; pinhead caseous node.

No. 74 - male, 57 years. Mitral stenosis, syphilitic aortitis. Fibro-tubercular area involving lung and pleura on anterior aspect of each upper lobe at or near apex about 1½ inch square and invading lung to depth of ¼". In left lung there was also a calcareous node ¼" diameter. Gland at bifurcation of trachea calcareous.

No. 418 - female, 33 years. Subacute bacterial endocarditis with mitral stenosis and incompetence, tricuspid stenosis and incompetence, aortic stenosis. In right lower lobe calcareous spicule.

No.345 - male, 22 years. Congenital syphilis, rheumatic stenosis of aortic, mitral

and tricuspid valves. Chronic venous congestion. He had acute rheumatism at 9 years and heart failure since 14 years. Lungs clear of tubercle. Groups of six calcareous glands in the mesentery near the caecum, each averaged $\frac{1}{4}$" diameter.

No. B. 19 -female, 28 years. Mitral stenosis. No signs of tubercle in lungs. In the mesentery were 4 calcareous glands with caseous centres from $\frac{1}{2}$ to $\frac{3}{4}$" diameter lying near the caecum . Behind the peritoneum on either side of the aorta were several other calcareous glands with caseous centres, about 1"x$\frac{3}{4}$" x $\frac{1}{2}$".

No. 209 - female, 40 years. Mitral stenosis, chronic venous congestion. No tuberculosis.

No. 270 - female, 44 years. Mitral stenosis, chronic venous congestion. No tuberculosis.

No. 363 - female, 50 years. Mitral stenosis, chronic venous congestion. No tuberculosis.

No. 417 -female, 20 years. Mitral stenosis, chronic venous congestion. No tuberculosis.

Out of nine in this group, 5 had anatomical

tubercles; that is equal to a percentage of 66 which is not much below the figure for the whole series. These examples of mitral stenosis are fairly evenly distributed among the decades of early and middle adult life and show that mitral stenosis does not always kill at a comparatively early age. All the cases except No. B.19 had marked venous congestion. It cannot be said that the tuberculosis in any way accelerated the demise of any of these patients. No. 345 was the only one in which the date of onset of the mitral stenosis could be definitely stated. It is significant that tubercle affected only the abdominal glands, very probably before the venous congestion had become established. Presumably in the others mitral stenosis had commenced before adult life was reached.

No. B.19 was the only instance of large tuberculous lesions; strange to say, this patient who died at the early age of 28 had very little chronic venous congestion in any organs. The glands were all calcareous and of large size although the mesenteric ones had caseous centres.

The only case with a completely caseous lesion was No. 19. It was a very small inactive lesion and occurred in a markedly anthracotic lung. The remaining three cases were of small localised calcareous lesions.

Tuberculous and mitral stenosis do therefore occur in the same individuals. It would appear, however, that the incidence of the bacillary disease is slightly below its usual level amongst those suffering from mitral stenosis with it's concomitant venous congestion. This latter condition has therefore a beneficent effect on the tubercle, limiting its spread and promoting calcification in a much higher proportion of cases than is usually found.

One example of congenital heart disease with well marked chronic venous congestion was met with in this series. It was a female patient aged 18 years -No.16. Incidentally no spleen was found in the body nor was there any scar suggesting that it had been removed by operation.

Polycythaemia accounted for another case with chronic venous congestion and without any signs of tuberculosis. No. 164 - female, 51 years. There were fibrous adhesions over the right lung.

It was not possible to classify all the tuberculous lesions according to their size on account of the variations in size and the multiplicity of combinations of different lesions in their distribution.

The following list includes a few examples from the more common types which were found in the series.

395 - male, 52 years. Cerebellar haemorrhage. Right lung 2" below apex on axillary surface calcareous node $\frac{1}{4}$" diameter embedded in fibrous tissue.

93 - male, 53 years. Uraemia. Right lung, loose adhesions over anterior surface of upper lobe. Lower lobe mear latero-inferior margin calcareous node $\frac{1}{4}$" diameter and another half that size in lower part of right upper lobe.

116 - male, 36 years. Encephalitis Lethargica. Right lung loose, fibrous adhesions, ultimate apex just beneath pleura caseo-calcareous nodule $\frac{1}{4}$" diameter in centre of some nodular fibrous tissue $\frac{3}{4}$"x $\frac{3}{4}$"x$\frac{3}{4}$".

138 - female, 77 years. Acute Pancreatitis. Left lung, firm adhesions over apex, with fibrous plaque on pleura $\frac{1}{2}$" x $\frac{1}{2}$". Calcareous node $1\frac{1}{2}$" below and to outer side of apex, 1" diameter. Anterior surface near lower anterior pole calcareous node $\frac{3}{4}$" diameter. Towards postero-inferior surface two $\frac{1}{2}$" nodes. Two $\frac{1}{2}$" nodes in lower lobe on anterior surface, Right lung ultimate apex calcareous node 1" diameter. Five other nodes in upper lobe and three in lower lobe, all about $\frac{1}{2}$" to $\frac{3}{4}$" diameter.

234 - male, 52 years. Broncho-pneumonia. Left lung, in centre of upper lobe calcareous nodule 1/8th diameter enclosed by fibrous tissue.

263 - female, 72 years. Acute Peritonitis. Left lung, adhesions at apex and base. Thick fibrous plaque at apex 2" x 1" x $\frac{1}{4}$". Right lung, adhesions at apex and thick fibrous plaque 2" x 2" x $\frac{1}{4}$" with some calcareous spicules towards the outer edge. The microscopic appearance of the fibrous plaques was loose fibrous tissue containing many blood vessels which were engorged with blood. Numerous phagocytic cells with carbon pigment were in some of these blood vessels.

The above examples show that tubercles develop in various parts of the lungs without necessarily affecting the apices, though when a large number of unselected cases is taken, the apex is found to be the site of election. Even large areas of tuberculous consolidation as in No. 139 may become calcareous. That was not the only case of such extensive calcareous deposits.

390 - female, 37 years. Right lung, lower lobe calcareous node $\frac{1}{2}$" diameter. Right tracheo-bronchial and broncho-pulmonary glands calcareous, sizes

varying up to 1" diameter.

158 - female, 43 years. Tumour of spinal cord. Right lung, fibrous thickening of pleura and lung at apex 2"x 1" x ¼". Right tracheo-bronchial glands contain calcareous spicules.

159 - female, 80 years. Broncho-pneumonia. Right lung firm fibrous adhesions especially at apex and posterior surface. Two calcareous nodes each ¼" diameter 3" below apex and on anterior surface. Left lung completely adherent to parietal pleura. Immediately under apex group of 4 calcareous nodes each about ¼" diameter. From the hilus to inferior surface of lower lobe a string of calcareous and caseous nodes up to 1/8th diameter. Calcareous nodes in bronchial glands. All the calcareous and caseous nodes were enclosed in fibrous tissue.

176 - male, 38 years. Pyaemia. Left lung 2" below apex of upper lobe calcareous node 1/8th diameter. Two bronchial glands near hilus and within the lung calcareous each ¼" diameter. One gland on left side of trachea contains calcareous spicules.

198 - female, 65 years. Hypostatic pneumonia. Right lung, adhesions at apex. Fibrinous pleurisy over lower lobe. At apex a tuberculous nodule and two caseous nodes with considerable fibrous tissue causing slight puckering of pleura but no extensive whiteness thereof. The whole area extends to 2" x 2" x 1". Microscopically there was necrosis with giant cells. Right tracheobronchial gland contains calcareous nodule ½" x ¼".

323 - female, 37 years. Right lung, lower lobe at junction with middle lobe near sternum calcareous node ¼" x ¼" x½". Gland under bifurcation of trachea was calcareous ½" x ½" x½".

328 - female, 45 years. Myocarditis. Right lung, extensive adhesions, puckered scars at apex. 2" below on posterior surface is calcareous node ¼" diameter. Left lung extensive firm adhesions, puckered scars at apex immediately below which calcareous node ¼" diameter. Left tracheobronchial gland calcareous 1/8th x ¼".

343 - male, 49 years. Peripheral neuritis. Right lung apex, calcareous node 1/8th diameter with puckering on surface of pleura. Tracheo-bronchial gland calcareous ½" diameter. Gland at bifurcation of trachea calcareous 1" x ½" x ½".

344 - female, 42 years. Cerebral haemorrhage. Lungs, adhesions over apices and anterior surfaces. Right lung, three calcareous nodes in upper lobe, ½" diameter, 1/8th diameter and ¼" diameter. Tracheo-bronchial glands contain calcareous spicules.

394 - female, 60 years. Fractured skull. Right lung completely adherent. Fibrosis of pleura at apex. Right bronchial gland calcareous ¼" x ½" x ½". Left lung not adherent, no scar tissue on pleura, 1" deep to apex caseous node ¾" diameter with surrounding fibrosis. Left broncho-pulmonary gland calcareous ¼" x ½" x ½".

3 - female, 77 years. Auricular fibrillation. Adhesions at apices of both lungs. Calcareous node 1/8th diameter at apex of left lung. In front of bifurcation of trachea calcareous

gland ½" x ½" x ½".

From the above, cases may be taken to illustrate the lack of a constant relation between the size of the modules in the lung and in the tracheo-bronchial glands. Caseation occurred in the lungs with calcareous deposits in the regional lymph glands. The gland lying immediately below the bifurcation of the traches was involved comparatively frequently either alone or in association with other glands or the lungs. Only occasionally was the gland lying in front of the bifurcation the only site of tuberculous lesion. The involvement of glands on the opposite side of the mid-line to the lung lesion was noticed occasionally.

95 - male, 13 years. Tracheo-bronchial and broncho-pulmonary glands studded with caseous material. One paratracheal gland ¾" diameter completely caseous.

100 - male, 52 years. Right tracheo-bronchial glands contain a few calcareous spicules.

141 - male, 29 years. Paratracheal and tracheo-bronchial and broncho-pulmonary glands caseous. Two of the broncho-pulmonary glands were in each lung and were 1" in diameter.

148 - female, 44 years. Right tracheo-bronchial glands contain a few calcareous spicules. Bifurcation gland calcareous 1" x ¾" x ¾" encapsulated by fibrous tissue.

143 - male, 65 years. Left lung, adhesions between lower anterior pole of lower lobe and mediastinum, and loose adhesions between upper and lower lobes. Left tracheo-bronchial glands contained milletseed calcareous spicules. No abnormalities in right lung and glands.

192 - male, 43 years. Lungs slight scarring at both apices over area 1½" x ½". Left broncho-pulmonary gland calcareous ¼" diameter. Left tracheo-bronchial gland calcareous spicule

242 - female, 50 years. Malignant endocarditis. No scars or adhesions on lungs. Right paratracheal and broncho-pulmonary glands contained some caseous nodules about ¾" diameter.

210 - female, 21 years. Lobar pneumonia and empyaema. Right paratracheal gland, calcareous nodule ½" diameter.

238 - female, 40 years. Carcinoma of Cervix Uteri. Left bronchial gland

calcareous node ¼" diameter .
Bifurcation gland calcareous
1" x ½" x ½".

These examples taken from the series of thoracic gland cases indicate the usual locations of tubercles in those glands. In some the glands within the lungs are the site of disease, but it is the glands round the main bronchi which are most commonly involved. The size of some of the glands is so great as to press on the air tubes even when they have become calcified. Considering these glands from the clinical point of view, it will be seen that the diagnosis by physical signs must be difficult unless we get evidence of partial obstruction of the bronchi.

410 - male, 42 years. Right lung no scars or adhesions. Gland at root between mid and lower lobes calcareous 1" x ½" x ½".

Bifurcation gland calcareous 1" x ½" x ½".

11 - female, 68 years. Chronic parenchymatous nephritis. Lungs, firm adhesions over both. No scars. Glands all enlarged with carbon and at right root was found a caseous node 1/8th diameter. Bifurcation gland calcareous 1½" x ¾" x ¾".

13 - female, 30 years. Several groups of calcareous glands of various sizes in mesentery near ileo-caecal region.

194 - female, 80 years. Mesenteric gland near spleen, calcareous ½" diameter.

208 - male, 26 years. Mesenteric gland near caecum, calcareous ½" diameter.

233 - male, 23 years. Subacute bacterial endocarditis. About centre of mesentery caseous gland with calcareous cap on one end - 1¼" x ¾" x ¾".

243 - female, 11 years. Broncho-pneumonia. In centre of mesentery group of four calcareous glands 2" diameter.

366 - female, 21 years. Ruptured stomach and kidney. Caseous gland with calcareous casing, in mesentery near caecum, 1" diameter.

19 - female, 28 years. Mitral stenosis, Heart failure. Mesentery; three or

four caseous almost calcareous glands ½ - ¾" diameter in centre and near ileo-caecal region. Retro-peritoneal glands similar consistence but larger up to 1" x ¾" x ½" on right and left sides of aorta extending as high as the level of liver.

385 - female, 21 years. Right lung calcareous spicule near apex. Mesenteric gland, calcareous ¾" diameter.

137 - female, 55 years. Endothelioma of skull and meninges. Left lung, lower lobe anterior surface, calcareous node ½" diameter enclosed by fibrous tissue. Tracheal and bronchial glands contained caseous nodes of various size up to ¼". Nearly one dozen mesenteric glands enlarged and caseous, sizes from ¼" to 1½" in diameter. Retro-peritoneal glands caseous.

252 - male, 37 years. Osteitis Fibrosa. Left cervical gland at apex of mastoid process calcareous 1" x ½" x ½". Calcareous spicules in broncho-pulmonary glands. Mesenteric gland near caecum; calcareous ¼" diameter. Scars on each lung apex 1½" x 1".

329 - male, 72 years. Acromegaly; auricular fibrillation. Right lung apex, white scars 1" x 1" and 1½" x 1" the latter with a calcareous spicule deep to it. Left lung apex white scar 1" x 1". Mesenteric glands - three groups of three or more calcareous glands, the larger ones up to ½" diameter.

334 - female, 62 years. Cerebral haemorrhage. Lungs, adhesions over anterior surfaces. Left root near bronchus a white depressed scar about 1" x 1" and immediately subjacent fibrosed nodule 1" x 1" x 1" with a calcareous mulberry-shaped core ½" x ¼" x ¼". Mesenteric glands calcareous, ¼" x 1" near caecum - another ½" diameter near centre.

401 - female, 78 years. Cerebral haemorrhage. In centre of mesentery causing a considerable amount of puckering a calcareous gland 2" x 1" x1".

It is apparent that most of these lesions were easily found on performing the post-mortem but that a few required a diligent search. These examples have been selected as illustrating the common sites of tuberculous lesions and the ultimate size. The smallness of many of the pulmonary nodules would prevent them being discovered <u>intra vitam</u> by physical

signs even allowing for a larger area being involved while the tubercle was in an active state before calcification occurred. This applies more particularly to the glands around the trachea and bronchi. So it behoves a clinician when examining a patient suspected of tuberculosis from the symptomatology to use the finest refinements of his physical signs not only for the apices of the lungs but over every available area of the lungs, and as close to the root of the bronchi as possible. It is to be remembered that the bronchial glands alone are involved in 15 per cent. of cases and that the lesions are seldom larger than ½" diameter. The abdominal glands, while occurring alone with comparatively small frequency are usually situated about the centre of the mesentery or the ileo- caecal region and should be sought for in the umbilical and right iliac regions during life. Their usual size renders them comparatively obvious when the abdomen is opened but is too small to be palpated through the abdominal wall unless it is very thin and lax.

DISCUSSION

These observations were prosecuted during a sufficiently long period to include a large variety of cases and thereby to exclude the possibility of selection. The cases examined may be taken as representative of the population of Edinburgh and the surrounding counties. Children under twelve and patients suffering from zymotic diseases and tuberculosis are treated in special hospitals; such of these as are admitted to the Infirmary are therefore few in number and of little value for statistical purposes. By making all the observations myself a uniform standard was kept throughout the work.

On examining the work of previous observers one is struck by the divergence of the results obtained. For example Naegele and Reinhart found amongst their adult cases that 98 per cent. and 96 per cent. respectively were tuberculous. These were from hospitals which admitted tuberculous cases as a routine. The proportions of deaths from tuberculosis were approximately the same in the hospitals and in the Cantons in which they are situated. Among the industrial population of St. Louis, U.S.A. Opie found a 100 per cent. of cases with tuberculosis. In this hospital tuberculosis patients were not admitted. At the other end of the scale we find Lubarsch records 35 per cent. of cases positive in Zwickau i Sa and

Birsch-Hirschfeld 41 per cent. in Leipsig.

Similar observations have been made amongst selected populations as was done during the Great War by both German and British pathologists. Obendorfer found 10 per cent. and Hart found 34 per cent. of the bodies which they examined to be tuberculous. Shore examined the bodies of 2059 soldiers from various parts of our Empire and recorded 9 per cent. with healed tubercles. I do not know how carefully he was able to prosecute his search, but the figure (9 per cent.) which he obtained is noteworthy. His cases represented all classes and types of the Empire coming from town and country after a very careful medical examination, so that only the healthy males between the ages of 19 and 30 roughly were included . That being the case we would expect the general population at home to show a larger proportion of tuberculosis including active disease. As the conditions in cities are more favourable for the propagation of tuberculosis the incidence would be much higher still and especially among the poorer classes who come to hospital. Therefore the figures of Shore are not exactly comparable to those obtained at home, as for example those of Kingston Fowler. Taking these facts into consideration it is incredible that Kingston Fowler considers the 9 per cent. of Shore as accurately confirming his own and Sydney Martin's previous

GRAPH 8

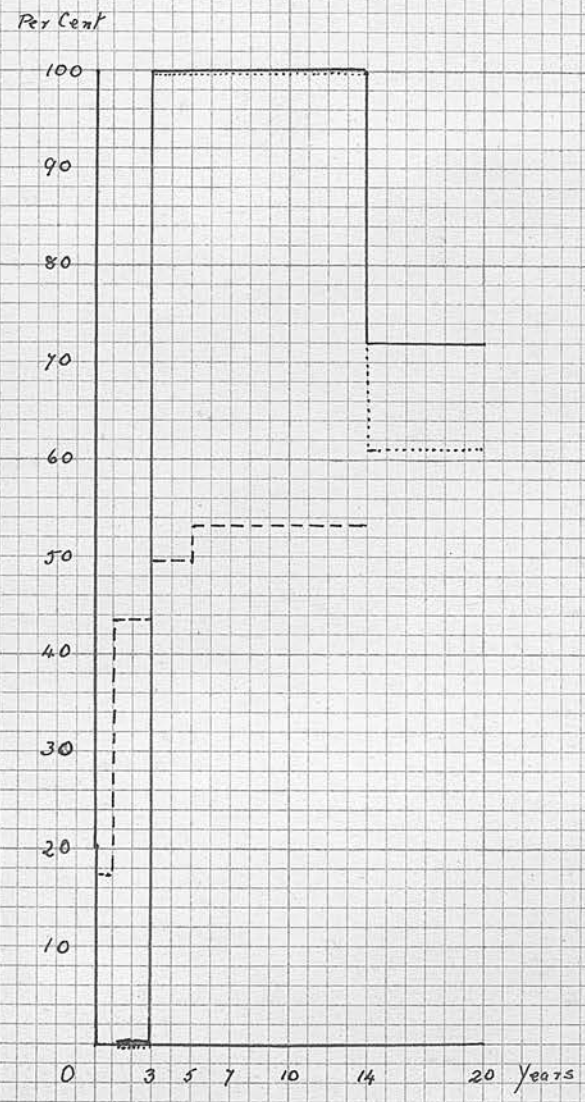
——— TOTAL TUBERCULOUS CASES TABLE I

– – – – TOTAL TUBERCULOUS CASES, FATAL TUBERCULOSIS EXCLUDED TABLE V.

TABLE X

CASES UNDER 20 YEARS OF AGE COMPARED WITH THOSE OF SHENNAN.

YEARS	TOTAL SERIES			TOTAL NON-FATAL SERIES			SHENNAN'S SERIES.		
	No.	No positive	%	No.	No. pos.	%	No.	No. pos.	%
0-1	0	-	- -	0	-	-	381	67	17.6
1-3	1	-	-	1	-	-	418	182	43.5
3-5	2	2	100	1	1	100	171	85	49.7
5-14	5	5	100	5	5	100	307	163	53.1
14-20	22	16	72	18	11	61	0	-	-



GRAPH 9

FROM TABLE X

——— TOTAL TUBERCULOUS CASES

..... " " " FATAL TUBERCULOUS EXCLUDED

– – – " " " SHENNAN'S SERIES.

observation of 9 per cent. in London. As a matter of fact they prove that the London figures were too low, taking into account the differences mentioned above. Kingston Fowler quotes statistics to show that the death rates from tuberculosis have been decreasing during the last 50 years, and yet he believes that the amount of healed tubercle in the body is the same after an interval of 30 years !

It would have been interesting if Miss MacGregor had continued her observations in order to get a larger number of cases, and if she had divided them into the same age periods as Shennan did. He showed a decrease in all the anatomical divisions between his first series of observations during the years 1886-1902 and the second series for 1910-1913. Her results would then have afforded an interesting comparison with these two previous series.

My figures are from people in the same hospitals' area as examined by Shennan, and they may be considered as an extension of his observations into adult life, with the reservation that the numbers in the age groups below 20 years are comparatively small.

All the curves referred to must start at Zero. Shennan's figures show that during the first year of life tuberculosis has affected 17.6 per cent. and that during the 2nd and 3rd years it rises rapidly to 43.5 per cent. Then they show very little increase between

3 years and 14 years. My curve has the same character but on account of the smaller numbers it may be subject to error on this cause. It shows the same rapid rise in the first decennium but rises to about 55 per cent. as opposed to Shennan's figure of 43.5 per cent. At this level it remains till 50 years when there is another increase. An analysis of my figures divided into the same age periods as Shennan used may be interesting but is less valuable for the reasons mentioned above. However the curve shows the rapid rise in the 4th and 5th years to a very high level, which is maintained till the fifteenth year, when the average level for adult life is found.

The examination of my cases in their anatomical distribution is instructive. Amongst the cases not dying of this disease, it will be seen that tuberculosis selects the abdominal glands in children and the lungs and bronchial glands in adults. Graph 6 shows that the highest incidence of tubercular mesenteric glands is in the first decennium. Remembering that these curves start at Zero we must conclude that a great incidence of abdominal tuberculosis occurs in the period 0-10 years, and when Shennan's larger group is consulted the greatest incidence will be seen to occur in the period 0-5 years. After the acme of the curve at 10 years there is a steady decrease till 50

years.

The rise of the curves for bronchial glands and lungs counterbalances the drop of the abdominal lesions, with the result that in the total population there is a fairly steady incidence of tubercular lesions between the ages of 5 and 50 years, after which a second rise occurs. The crossing of the two types of curves occurs about 40 years.

The possible causes of the persistent decline in the abdominal tuberculosis rate were discussed earlier, and the conclusion arrived at was that the calcareous and caseous nodules were absorbed. Weight is lent to this argument by the frequently quick recovery observed clinically in cases of abdominal tuberculosis.

The question arises as to what happens to these cases which eliminate tuberculous lesions from their abdominal glands, and whether they develop an immunity from tubercle which persists for the remainder of their lives. If so from my figures, the remainder of the cases not so infected in infancy must all become infected in other sites later in life, and as more than 50 per cent. under 5 years of age have tubercular abdominal gland lesions there would only remain about 40 per cent. of adults available for tuberculosis in other organs. That process would allow the total curve to remain fairly level, but it requires that all cases not affected in childhood become affected as

adults, as the total percentages in adults is about the same as for abdominal glands in children. Then all the adult cases without any visible signs of the disease would have been cases of completely healed abdominal lesions. This would seem to be highly improbable. It is known that when tuberculosis affects adults primarily it assumes the infantile or glandular form and runs an acute course with a speedy demise as for example, tuberculosis among primitive people.

We must conclude , therefore, that of the mesenteric cases which completely heal, in a large proportion tuberculosis manifests itself in some other organs such as the bronchial glands and lungs and that such immunity as may have been developed must have been very imperfect. Then the important question arises as to whether this is a second infection or a lighting up of a dormant infection.

If it were a second infection where all the previous foci of disease had disappeared and no immunity had been achieved, then it would be equivalent to a primary infection in virgin soil. The character of this form of the disease is quite different to what is usually met with in civilised adults and has been described already. As usually met with in civilised peoples, the adult type is a slow infiltrative process usually of the lungs, and all forms tend to arrest and

heal as shown by the figures in this series. If there still remain some bacilli in the body or small lesions as the result of the original disease a second infection would produce the Phenomenon of Koch. This is the formation of a small and localised abscess at the site of the second inoculation which rapidly ulcerates and then heals. When the invading organisms are inhaled a violent capillary congestion occurs in the lungs along with a exudative alveolitis. The interpretation of this phenomenon is that after a certain period has elapsed from the first inoculation the defensive mechanism of the body comes into action and a second dose of organisms stimulates it to much greater activity so that it causes rapid caseation and breaking down of tissues in and around tuberculous foci. This explains the occurrence of caseous tuberculosis in adults exposed to repeated doses of tubercle bacilli after having been tuberculised in childhood. This is quite a different manifestation to the primary disease in adults which is firstly granular and then miliary.

On the other hand a lighting up of a dormant infection would explain the rising incidence of certain forms of tuberculosis in adult life. We must suppose that as the abdominal gland lesions heal some of the bacilli have escaped and migrated to other glands, there to lie quiescent till a re-infection occurs, when they act as a nidus of the disease and so are the local cause of caseation, or some of the bacilli may migrate

and set up a focus of disease in some other organs. The former seems to be more likely as my figures show that the greater incidence of the bronchial glands and pulmonary types occur after adult life is reached. This is explained by the individuals at that age coming into close association with tuberculous subjects who pass on their bacilli, which when they are absorbed stimulate the defensive properties of the body which sets up caseation round the original organisms. The second rise in old age may be accounted for by a similar reaction, but here the reactionary processes of the body have become dormant after a long period of quiet activity, and then they give a much greater response as old age comes on.

This reactivation of the original disease might be due to another cause,namely, the lowering of the resistance of the body to disease. It is not necessary here to discuss what these causes are, but they are very prevalent amongst those who are so frequently exposed to repeated re-infection.

The reactivation of the disease in other organs explains the rise in the curves of bronchial gland and pulmonary lesions as the mesenteric curve drops.

Having proved that tuberculosis of the mesenteric glands heal and become completely absorbed, it follows that the figures for adults do not show all the cases which have had tuberculous disease but only

those in which the lesions have not entirely cleared up. Therefore we must accept the fact that the people who have been tuberculised form a definitely higher proportion of the population than my figures show, namely, 69 per cent. In view of these facts all statistics bearing on this point must take into consideration the age constitution of the population examined.

My results are also of value in reference to the tuberculosis rate in adults. The figures obtained by various observers in Germany for the same class vary between 35 and 60 per cent, The country which might be termed the sanatorium of Europe contains the two cities, Zurich and Berne, with the greatest amount of tuberculosis in their inhabitants as proved by post-mortem statistics. It is clear then that under the best climatic conditions tuberculosis thrives to the extent of being able to infect well over 90 per cent. of the adult population. Two thirds of the cases showed the tubercle to be quiescent. What is the reason for this high rate compared with other countries ? Have Naegele and Reinhart accepted any scar as proof of tuberculosis, or have Birsch-Hirschfeld, Hart, Shore, myself and the other observers not been diligent enough in our search ? The answer will be found in the local conditions. The towns with the highest incidence will be found

to be those with bad sanitary arrangements, and in which the people live closely packed in their houses at night even though they work in the open during the day. It is during social intercourse that these bacilli have the best opportunity of passing to other hosts. Another point to be considered in this connection is the chance of infection by milk. Milk is a carrier of tubercle bacilli chiefly to infants and children and in them causes the glandular type of the disease. Naegeli showed 17 per cent. of 88 cases and Reinhart 29 per cent. of 72 cases under 18 years of age to be tuberculous, and then a much larger proportion, namely, over 90 per cent. of those over 18 years. In Edinburgh, Shennan gound 38 per cent. of 1277 children's bodies under 14 years to have lesions. The difference between my figures and those of Naegeli and Reinhart is that 69 per cent. represents the amount of tubercle for all ages, including children, as well as for adults only. They give 70 per cent. as the figure for all ages with a much lower incidence in childhoos and a complementally greater proportion in adults.

In this country we have a large amount of tuberculous infected milk, and we know that bovine tuberculosis is rife amongst children. Post-mortem results confirm this. The Swiss observers stress

the point about the increasing tuberculisation during adolescence, so it would appear that bovine infection plays a lesser role in Switzerland than it does in this country. In the sanatoria the full benefit of the climate is obtained. They are situated at higher altitudes than the towns and escape the smoke and other atmospheric pollutions. The patients are not herded together and each gets the fullest amount of clean air and sunshine throughout the twenty-four hours. If the normal inhabitants of Berne and Zurich adopted sanatorium principles in their own methods of living, they would have one of the lowest tuberculosis rates in Europe. Switzerland, undoubtedly, has an exceptionally fine climate for tuberculosis patients and therefore for healthy subjects.

Taking the Edinburgh lesions we find that 71 per cent of them were calcareous, that is healed, and only 13 per cent. of them were active and another 13 per cent latent. These proportions compare favourably with those of Berne. In spite of the lack of sunshine and other unfavourable climatic conditions in Edinburgh the incidence of tuberculosis is lower and the relative proportion of those lesions which have completely healed is more satisfactory.

We have seen that many of the non-fatal tuberculous lesions were small solitary nodules. Although such lesions may be small and localised, they were in

many instances involvement of two or more organs. Take as an example the lungs, which were most frequently the only organ affected (Table VI.) They alone were infected 78 times or 20 per cent. The number of cases in which the lungs alone and with organs were infected was 153 or 39.6 per cent. Table VI shows that the lungs and the lymphatic glands were the only tissues which are affected with tuberculosis apart from other organs, that is, they are the only sitesof primary tuberculosis. We must conclude from this that when tubercle is discovered in one of the organs, in about one half of the cases another organ will also be found to be affected. Conversely tubercle in kidneys or bones, etc. requires that a search be made in the glands or lungs for the primary site. From Table I it will also be seen that the bronchial glands are the commonest glands to be involved by this disease. In the majority of cases it is impossible to discover their enlargement by the ordinary methods of physical examination. It has been pointed out above how small the tubercles in these glands so frequently are. These lymph glands lie alongside the trachea and bronchi, and when tuberculous lesions develop in them they enlarge and press on the neighbouring structures. The lung being more resilient will give way first, but in some cases and especially those with the larger calcareous or caseous masses the enlargement has developed towards the tubes

and consequently pressed against them. This applies particularly to the gland immediately below the bifurcation of the trachea. In several instances the glands are seen to be enlarged to the extent of causing an indentation in the wall of the bronchus. Before calcification has occurred, the gland is in a state of caseation. Tubercles are subject to congestive attacks from various causes. When congestion occurs in the glands it causes them to enlarge and exert more pressure on the tubes. When partial obstruction occurs in the air passages a cough is set up, usually of a spasmodic nature. In some cases then these enlarged glands are the cause of attacks of spasmodic asthma. The attacks are liable to be more marked when the tuberculous lesions are in a state of activity or congestion, so that we shall expect to find some symptoms and signs of tuberculous toxaemia also present.

The kidney was mentioned as an organ in which no healed tubercles but only active lesions were found. This is in accordance with the facts stated in the literature. In most of the cases the primary lesion was calcareous. The kidney is always active and although the individual glomeruli and tubules rest in rotation the cycle is too short to allow of any healing to take place. A tubercle is so large that some portion of it is bound to be in contact with functioning units of the kidney. The lung has a fresh air supply which helps in the

arrest of local tubercle. The liver and spleen do not work at such pressure as the kidney, and in the former large areas are available for periods of rest.

Glands and joints are almost automatically cut off from physiological and anatomical activity when they become the site of tuberculous infection. Anatomical rest usually occurs as pain so frequently accompanies movement of the parts. The blood and lymph channels in these two types of tissue are early occluded by the pathological changes.

CONCLUSIONS.

1. Tuberculous lesions were found in 69 per cent. of persons (386) who died in the Royal Infirmary, Edinburgh, from disease other than tuberculosis.
2. In 50 per cent. of cases calcareous, that is healed lesions were found.
3. In 9 per cent. the lesions were quiescent and in another 9 per cent. they were active.
4. Lungs and tracheo-bronchial glands are the organs most frequently involved in adults.
5. Lungs, tracheo-bronchial glands and mesenteric glands in that order, are the most common sites of tubercle.
6. Other organs, except cervical glands, are always infected secondarily to those mentioned above.
7. Tuberculosis of the kidney is always secondary and does not heal.
8. There is evidence of a marked tuberculisation occurring during infancy of abdominal type and of a late and more constant tuberculisation affecting lungs and bronchial glands in later life.
9. Evidence is afforded by the figures relating to abdominal glandular lesions of a marked

tendency for these lesions to disappear within the individual. The degree of tuberculisation of the population must therefore very considerably exceed the percentage of the tuberculous lesions which have been proved in this series of examinations. It must be greater than 69 per cent.

10. The facts which have been obtained from the study of this particular population indicate that in order that correct conclusions may be obtainable from post-mortem material, the factors of age incidence with respect to the various manifestations of the disease must be taken into account.

11. From the facts demonstrated that tuberculosis in later life is mainly pulmonary in type and subacute or chronic in nature and that in a large proportion of cases the pulmonary must have been preceded in the individual by definite abdominal tuberculosis, it would appear that a resistance to this disease is active during later life, and that the disease in a large number of instances must have been due to a lighting up of an early infection and not to an re-infection.

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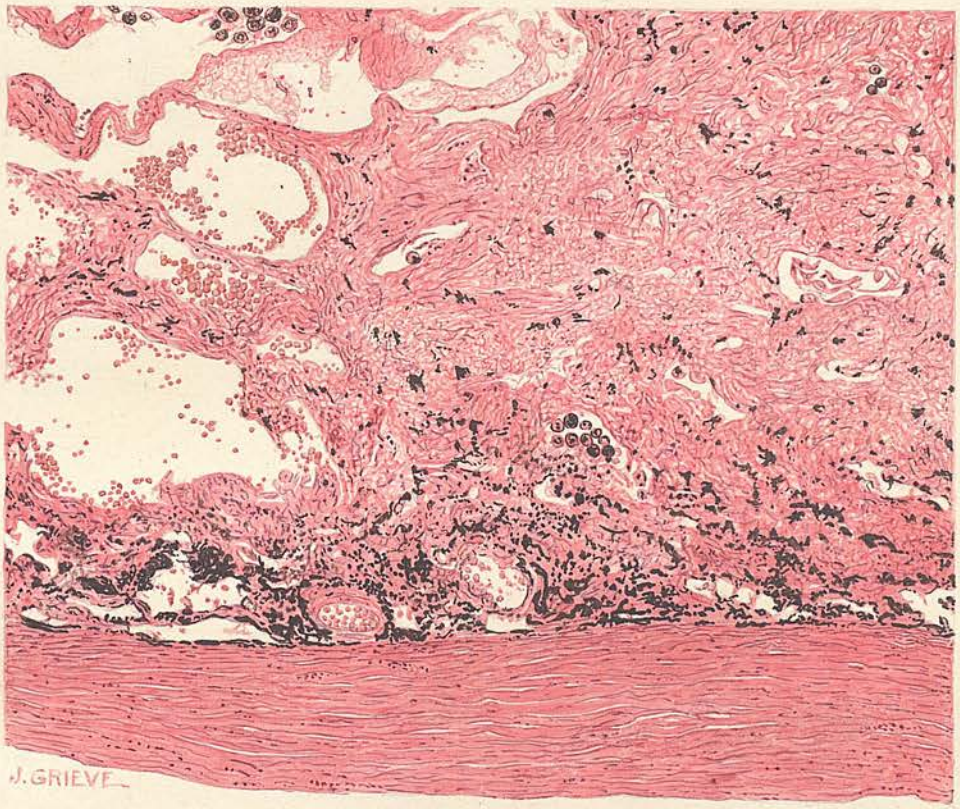
J. GRIEVE